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Contribution from the Bureau of Animal Industry
A. D. MELVIN, Chief

Washington, D. C. ▼ November 23, 1915

THE DOG AS A CARRIER OF PARASITES AND DISEASE.

By MAURICE C. HALL, Ph. D.,
Assistant Zoologist, Zoological Division.

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In the evolution of civilization the dog was one of the most useful animals ever domesticated by man. In addition to his usefulness, other admirable qualities have endowed him with a certain sentimental esteem as a pet. The part the dog plays as a carrier of disease, however, has only recently been recognized, and his status has not yet been changed to satisfy modern hygienic precautions or even to meet altered conditions of life in cities.

Whether in the city or in the country, the dog is commonly allowed a degree of freedom which is approached only by that of the less social and consequently less dangerous cat. Liberties which we do not allow our horses, cattle, children, or selves are extended by many persons to their dogs. They are permitted to run unquestioned over lawns or farms, to plant bones in flower beds, to litter up porches and walks with trash and filth, to lick the faces of children, to wipe their muddy paws on strangers' clothing, to go unmuzzled when rabies with its terrible agony and attendant death is abroad, and to roam afield at nights and run sheep to death.

NOTE.—This bulletin points out the increasing damage done by the stray and uncared-for dog as a carrier of parasites and disease germs harmful to both man and live stock, and is especially intended for the use of physicians, veterinarians, and health officers.

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As has been said, the dog himself has many delightful and useful qualities. It is our thoughtless tolerance of his present unwarranted liberty and license that permits this survivor of the days when the dog was man's faithful and valuable ally against the rest of the animal world to become a pest and a danger. There is a growing conviction that while his innate qualities and the fund of affectionate sentiment which attaches to him warrant the preservation of the dog with a responsible owner who will keep him clean and free from vermin of all sorts, hold him within reasonable bounds and restraint, and assume responsibility for his acts, on the other hand, the ownerless dog, the dog which carries vermin and disease, the dog which kills sheep or destroys property of any sort, the trespasser—these dogs must be eliminated.

The case against the unrestricted dog is based on two counts—that he is a nuisance and that he is dangerous.

That most dogs are allowed too many liberties and too much familiarity with people is a matter of common knowledge. Transgressions on the part of dogs range from simple trespass to the habit of biting without provocation and to the wanton killing of sheep.[1]

The direct monetary damage done by unrestricted dogs, while great, is even less important than the indirect harm they work as carriers of disease. It is the purpose of this paper to show how improperly-cared-for dogs act as agents in the spread of diseases, particularly parasitic diseases, affecting man and live stock.

DISEASES AND PARASITES CARRIED BY THE DOG.

Dogs probably play a part in the spread of diseases due to fungi, such as ringworm and favus, and are sometimes important carriers of bacterial and filterable-virus infections. In the recent outbreak of foot-and-mouth disease, it was determined beyond any reasonable doubt that dogs were responsible in some instances for the spread of the disease, not only from one farm to another, but from one State to another. The dog is of primary importance and in many instances the sole carrier in the case of many dangerous and even deadly animal parasites of man and the domestic animals, and is especially notorious as the carrier of rabies. Some of these parasites depend so absolutely on dogs as carriers during certain stages of their life history that they would probably or certainly become extinct if dogs were not available as hosts. The long list of important diseases and parasites which are conveyed by the dog to man and the domestic animals and which are present in this country is as follows: Rabies in man and stock; hydatid in man and stock; gid in stock (and possibly in man also);

[1] See Farmers' Bulletin 652, "The Sheep-Killing Dog."

muscular cysticercosis, or so-called "measles," in sheep; muscular cysticercosis, or "measles," in reindeer; cysticercosis of the liver and mesenteries in stock; tapeworm in man, especially in children; roundworm in man; tongueworm in man and stock; and fleas and ticks which transfer from the dog to man and which may in this way transmit disease and parasites. The above list is sufficient to show that the dog is of major importance as a carrier of parasites dangerous to man and domestic animals. An elaboration of the list follows.

RABIES.

It has been known for over 2,000 years that what are called mad dogs, those affected with the disease termed rabies, hydrophobia, or lyssa, could transmit this disease to stock and to man by biting them. For 2,000 years the disease has been reported in sporadic and epidemic outbreaks. It is now recognized as a widespread, acute, infectious disease of the central nervous system, characterized by extreme nervous excitability. It is a disease which, if untreated, leads to a certain death of the most horrible and agonizing sort. It owes its wide distribution and its very existence almost exclusively to the dog. The disease may manifest itself in dogs or other animals under the form of dumb rabies or furious rabies. In dogs there is commonly evidence of depraved appetite, the dog eating sticks, leather, and stones, and the finding of such things in the stomach is a suspicious indication of possible rabies. There is a partial or complete paralysis of the throat, and the resultant difficulty in drinking is the basis of the erroneous idea that the mad dog is afraid of water. As a matter of fact, such dogs are often very eager for water but are unable to swallow it. The disease seems to have some specific effect on the centers controlling biting, the feature on which transmission of the disease depends, and not only dogs but such animals as the horse show a tendency to bite when affected with rabies. The disease is suspected of being due to a parasitic protozoan, though as yet too little is known regarding this to warrant a definite statement. An examination of the brain of rabid animals shows certain cell inclusions known as Negri bodies (fig. 1), the nature of which is not at present well known.

It has been pointed out in a previous publication[1] of the United States Bureau of Animal Industry that rabies is becoming increasingly prevalent in the United States. That publication cites the fact that the New York Pasteur Institute had treated 1,608 cases of hydrophobia during the first 11 years of its existence, up to 1901. The Chicago Pasteur Institute, established at about the same time as

[1] Rabies and its increasing prevalence. By George H. Hart. Bureau of Animal Industry Circular 129. Washington, 1908.

the New York Institute, had treated 3,010 persons for hydrophobia during the first 17 years of its existence, up to 1907. The Baltimore Pasteur Institute had treated over 1,000 cases up to 1908. Many more such figures could be cited for the numerous other Pasteur

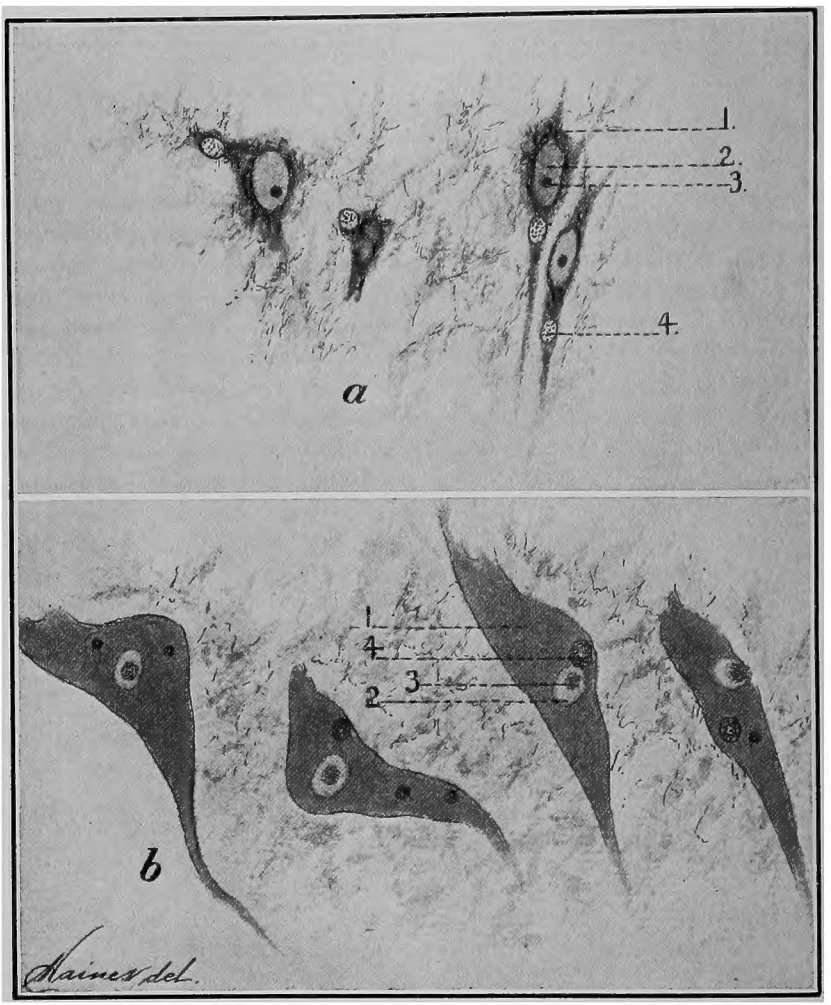

FIG. 1.—*a, b*, Nerve cells of the brain, showing Negri bodies, a diagnostic factor in rabies. 1, cytoplasm of cell; 2, nucleus of cell; 3, nucleolus of cell; 4, Negri body in cytoplasm of cell. (After Hart.)

institutes in this country. In 1908, 111 deaths of persons from rabies were reported in the United States, and owing to our inadequate statistical methods we have nothing like exact data in regard to the extent and distribution of the disease or the number of cases

and deaths. In 1911, according to Stimson,[1] there were 94 fatal cases in man, a decrease from the figures for 1908, which is probably due largely to the fact that in 1911 there were 4,625 persons treated for rabies in this country. Mohler[2] states that there are only three States in the Union—Idaho, Utah, and Nevada—from which it has been impossible to obtain positive information to the effect that cases of rabies have been found in them. The disease has since been reported from Idaho and Nevada.

Rabies is an easily preventable disease. In the present state of our knowledge as to its mode of transmission, there is no reason for its continued existence. It may be prevented and in time eradicated by simply muzzling dogs for a sufficient period to allow the disease to die out. Such a minor restraint on the dog as muzzling was sufficient to eradicate rabies from England. The first case since 1902 has just been reported in the spring of 1915, and this case occurred in a dog that was being held in the six months' quarantine which is enforced on all dogs brought into that country to prevent the disease being reintroduced. Australia and New Zealand have never had any cases of rabies, and a system of quarantine and inspection is provided to prevent its introduction. It has been practically or completely eradicated from Sweden, Norway, and Denmark by rigid enforcement of muzzling ordinances.

HYDATID.

Hydatid disease occurs in man, cattle, sheep, horses, hogs, and numerous other animals. It is caused by the presence of the so-called hydatid (technically known as *Echinococcus polymorphus*, *Echinococcus granulosus*, *Echinococcus multilocularis*, etc.) in such tissues as the liver, kidney, muscles, brain, lungs, etc. The hydatid is a bladder worm or larval tapeworm (fig. 2), and is characterized by its thick laminated cyst wall. The original bladder frequently develops daughter bladders on the inside or on the outside, and in these or the original bladder there develop brood capsules containing tapeworm heads. There are probably two species of hydatid, though they are commonly considered a single species. The bladder worms are often as large as an orange and may be as large as a child's head. Growth and the formation of daughter bladders may go on for an indefinite period. There have been cases in which hydatids have existed in man as long as 30 years before the death of the patient finally ensued. Their presence in the body causes various forms of

[1] Rabies in the United States during the year 1911. By A. M. Stimson. Public Health Reports, vol. 27 (28), July 12, 1912, pp. 1098–1101.

[2] Rabies or hydrophobia. By John R. Mohler. Farmers' Bulletin 449. Washington, 1911.

hydatid disease, depending on the location of the parasite. The effects are very serious and the prognosis is always grave. A conservative estimate gives a death rate of 13.6 per cent of the persons infected (Vegas and Cranwell). The growth of the bladder gives rise to various troubles as a result of pressure, obstruction, perforation of important organs, necrosis of tissue, liberation of poisonous products, secondary bacterial infections, rupture of the hydatid, and secondary hydatid infestation following rupture of the cyst. It is commonly necessary to resort to surgical interference for the removal of the hydatid. Operation is often very difficult and may have to be repeated, owing to the presence of small external daughter bladders which are easily overlooked or incapable of detection. A

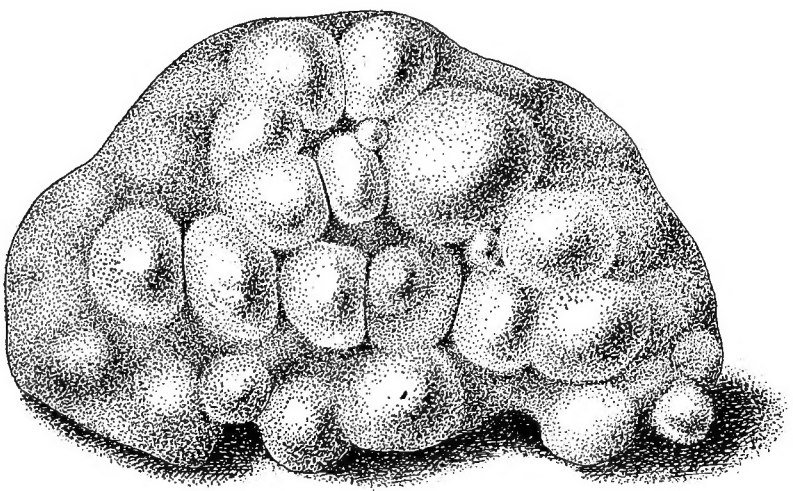

FIG. 2.—Portion of a hog's liver infested with hydatid bladderworm (*Echinococcus granulosus*). Natural size (after Stiles).

case has been recently recorded where the patient had to be operated on four times before the recurrence due to daughter bladders had ceased.

In the lower animals hydatids are probably less often a cause of death, owing to the slow growth of the parasite and the fact that the affected animals are likely to be slaughtered before sufficient time has elapsed for the parasite to become a menace to the life of the animal.

If brood capsules containing the tapeworm heads are eaten by dogs—a thing which is apt to occur on farms where the viscera of slaughtered animals, especially when they appear unwholesome, as they would in hydatid disease, are thrown out on the fields or fed to

dogs—these tapeworm heads pass uninjured to the intestine of the dog and give rise to numerous very small segmented tapeworms, *Tænia echinococcus* (fig. 3). The dog is practically the only carrier of this tapeworm. The tapeworm attains a length of only about half a centimeter (three-sixteenths of an inch) and consists of a head and three segments. The sexual organs develop in the second segment and eggs are present in the third segment. These eggs pass out in the feces of the dog and infect pasture, soil, and water. They are spread broadcast on grass, in drinking water, on products intended for human food, on children's toys, and on all sorts of objects in places frequented by the dog. The rooting habit of the hog predisposes it to hydatid disease, as it is extremely likely to swallow some of these eggs in feeding if there is a dog with the hydatid tapeworm anywhere around. But even the most careful persons have no assurance of safety where there are such dogs. Eggs from the feces of these dogs may wash considerable distances and ultimately land on lettuce, radishes, or other vegetables. They may get on the hand from contaminated tools or farm implements, or from the dog's skin. Persons who allow dogs to lick their hands or faces run the risk of acquiring and ingesting the eggs of this tapeworm. When such eggs, which are, of course, too small to be seen with the naked eye, are ingested by man or animals, the shell digests off and releases a small embryo armed with six hooks. By means of these hooks the embryo bores its way through the wall of the stomach or intestine and into the blood current. Here it is swept around till it lodges. At the point of lodgment the embryo starts to develop into the hydatid or bladder worm already noted. The parasite must always be transmitted from the dog to other animals by the ingestion of the egg from the tapeworm in the dog, and from other animals back to the dog by the dog eating diseased carcasses or parts of carcasses. It can not be transmitted in the form of the hydatid from an infected animal to another animal nor in the form of the tapeworm from one dog to another.

FIG. 3.—*Echinococcus granulosus* (*Tænia echinococcus*), the hydatid tapeworm from the intestine of a dog. Enlarged (after Leuckart).

Prevention depends in part on a proper handling of slaughtered animals and of those dying from any cause. An obvious aid in preventing this disease would be to destroy diseased portions of animals slaughtered for food or for any reason. This is best accomplished at

our large packing houses where such diseased portions are tanked at temperatures which insure the destruction of all parasites of any sort. On the farm it may be accomplished by boiling any viscera before feeding them to dogs or other animals. The viscera should never be thrown out on the fields. The practice is objectionable of itself; it furnishes a breeding place for flies and is in every respect insanitary and improper. Viscera and carcasses, if not cooked and fed, should be burned, buried with lime, or disposed of in such a manner that they can not be devoured by dogs.

An additional method of preventing hydatid disease, and the one that should be emphasized here, is for the owners of dogs to keep them up, and to have stray dogs disposed of by the proper authorities. A person should have substantially the same supervision of his dog's food, for his own sake and for the sake of the dog, that he has of his children's food. It is dangerous as well as unwholesome to allow dogs to forage for a living. A man who does not properly feed his dogs has a poor claim to their care and ownership. Dogs should be kept out of human habitations and treated in general with more regard to their possibilities as disease carriers.

Hydatid disease is fairly common in Europe. It is quite common in Iceland, India, Eastern Siberia, Algeria, Tunis, Australia, and some South American countries. It has been permitted to assume the proportions of a serious menace in Australia, and 3,000 cases of hydatid disease in human beings were reported from there between the years 1861 and 1882. In at least two South American countries hydatids are so common that the sanitary authorities have issued illustrated placards warning against the disease.

Over 240 cases of hydatid in man have been recorded from the United States up to 1902. Over most of the United States hydatids are comparatively infrequent in domestic animals, but they are not so rare that they are curiosities to meat inspectors. Numerous condemnations of organs and parts of carcasses are reported every year from the various meat-packing establishments under Federal inspection. Some recent abattoir figures show an alarming prevalence of this disease in domestic animals in some parts of this country, notably in certain localities in Virginia, Arkansas, and Oklahoma; and the prevalence of hydatids in domestic animals is an index of the danger to which people are exposed. It is, moreover, desirable that we apply preventive measures before a larger list of cases in man makes both curative and preventive measures imperative. The bare fact that hydatids occur at all in the United States is of itself a cogent argument for the suppression of the dog nuisance as a measure necessary for the public welfare.

GID.

Gid disease, like hydatid disease, is due to the presence of a bladder worm, or larval tapeworm, in the tissues. The bladder worm (known as *Multiceps multiceps* or *Cœnurus cerebralis*) (fig. 4) which causes gid resembles the hydatid bladder worm in that one bladder worm may produce large numbers of tapeworm heads, and the tapeworms resulting from these heads occur in the intestines of dogs, as in the case of the hydatid tapeworm. The bladder worm causing gid differs from the hydatid in that it has a thin, delicate, membranous wall instead of a thick laminated wall; it does not produce daughter cysts as the hydatid does, and it occurs only in the brain and spinal cord instead of in any tissue. The adult tapeworm in the dog, commonly known as *Tænia cœnurus* (fig. 5) attains a length of 2 or 3 feet instead of a small fraction of an inch.

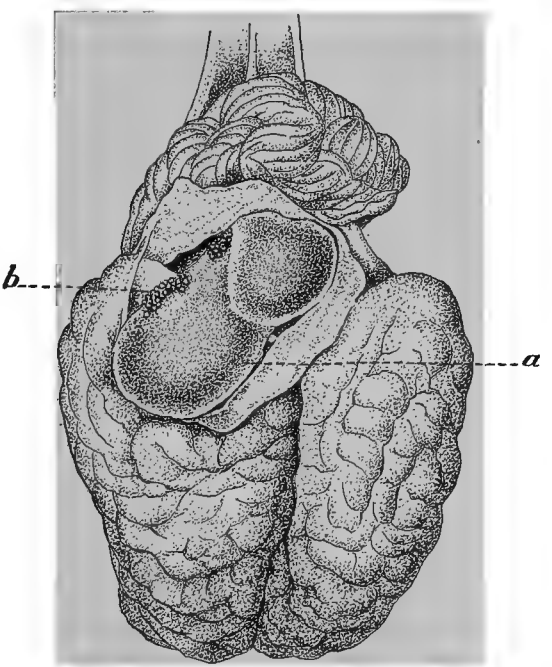

FIG. 4.—Brain of giddy sheep, showing gid parasite, *a*, Gid parasite or bladder worm; *b*, heads on bladder worm. (After Numan, 1850, Pl. I, fig. 1.)

Gid is principally a disease of sheep, though it is fairly common in cattle and there are some cases from the horse and the goat. In 1910[1] the writer stated that there were no valid cases of the disease in man. Since then Brumpt[2] has published one case which apparently must be accepted as a good case.

The life history of the gid parasite is practically the same as that of the hydatid. The gid bladder worm is called a cœnurus. When this cœnurus is eaten by a dog, the tapeworm heads on the cœnurus pass to the intestine of the dog and give rise to a tapeworm which

[1] The gid parasite and allied species of the cestode genus *Multiceps*. I. Historical review. By Maurice C. Hall. Bureau of Animal Industry Bulletin 125, pt. 1.
[2] Précis de parasitologie, 2d ed., pp. 281–283. 1913.

may attain a length of 2 or 3 feet. In the terminal segments are eggs, and these segments with the contained eggs pass out in the feces of the dog and contaminate vegetation, soil, and water. Such herbivorous animals as sheep, which graze over range or pasture contaminated in this way, pick up these eggs as they feed and swallow them. In the stomach of the sheep the shell is digested and the small, hooked embryo released. The embryo bores its way through the wall of the digestive tract and into the blood vessels and is carried around until it lodges somewhere. Embryos which do not lodge in the central nervous system start to grow, but very soon perish. Very commonly, however, the parasite makes its way to the central nervous system, lodging as a rule in the brain, though it occasionally occurs in the spinal cord. In the brain the embryo grows to form the bladder worm or cœnurus, and this may attain the size of an egg, or even a larger size. As it grows it presses upon the adjacent portion of the brain and destroys it. The pressure and the irritation, due to the hooks with which the tapeworm heads of the cœnurus are provided, cause very distinctive symptoms, the sheep commonly holding its head in an odd position and walking in a circle toward one side or the other. Unless the cœnurus is removed by operation the sheep invariably dies. When the brain of such a sheep is eaten by dogs—and dogs very readily eat the brains of sheep by licking them out through the large opening at the base of the skull—the cœnurus is ingested with the brains and the tapeworm heads pass to the intestines of the dog and give rise to the adult tapeworms. As in the case of the hydatid, the gid parasite must always be transmitted from the dog to other animals which eat the eggs from the dog tapeworm, and from the other animals to the dog by the dog eating the brain or at least the cœnurus from the brain of a giddy animal.

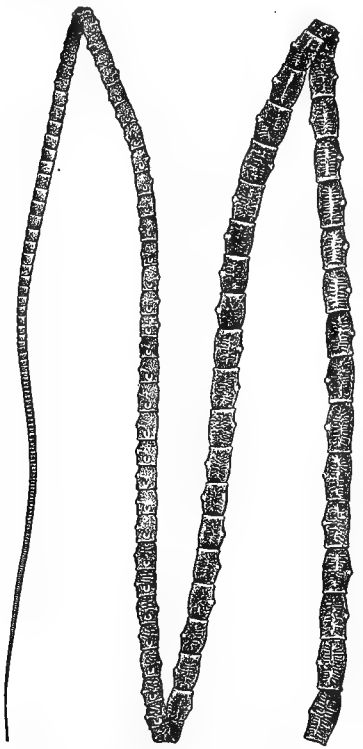

FIG. 5.—Adult gid tapeworm from the dog. Natural size. (Specimen No. 4031, Bureau of Animal Industry helminthological collection.)

One preventive measure for suppressing gid is, of course, to destroy the brains and the cœnuri of giddy animals, which can be done by burning them or by breaking the skull and covering the brain with formaldehyde, sheep dip, or some similar substance. Another measure is to administer a vermifuge to sheep dogs and so rid them of their tapeworms, and to do this often enough to keep them free from tapeworms. But it is obviously of little avail to a sheepman to have his own dogs free of tapeworm if his neighbor's dogs or ownerless dogs or strays of any sort are free to carry tapeworm onto his range or pasture and infect the grazing and thereby infect his sheep. From losses originating in this way he must be protected by measures looking to the restraint of dogs that recognize an owner and the elimination of those that do not.

Gid has been reported from several States in this country, but it is most prevalent in Montana, especially in the northern half of that State, where gid has had a foothold for a quarter of a century and where the losses for some years total about $10,000. There is evidence of the occurrence of gid in Arizona, and outbreaks have occurred in recent years in New York, Iowa, and Kansas. There have been reports, apparently correct, of its occurrence in Ohio, Illinois, Michigan, Missouri, Oklahoma, and Nevada. It is a constant source of loss in many European countries, and at various times has proved a veritable scourge to the sheep industry of these countries.

CYSTICERCUS (MEASLES) IN SHEEP AND OTHER ANIMALS.

Muscular cysticercosis ("*measles*") *in sheep.*—The presence of small bladder worms in mutton has recently been shown by Ransom[1] to be much more common than had been suspected, and to be due to a tapeworm in the dog and not to a tapeworm of man as had been supposed. His investigations showed that under careful inspection the percentage of affected sheep in this country has amounted to 2 per cent or more, and that approximately 20,000 sheep carcasses were retained in 1912 in abattoirs under Federal inspection on account of "sheep measles" due to this parasite.

The bladder worm, *Cysticercus ovis* (fig. 6), in the meat of sheep is oval and ranges in size from about one-third of a centimeter (one-eighth of an inch) to almost a centimeter (three-eighths of an inch) in length. Inside of this bladder there is a single tapeworm head, in which respect, as well as in size, this cysticercus, as it is called,

[1] *Cysticercus ovis*, the cause of tapeworm cysts in mutton. By B. H. Ransom. Journal of Agricultural Research, U. S. Department of Agriculture, vol. 1, pp. 15–58. 1913.

differs from a hydatid or a cœnurus. Numerous cysts, however, may be scattered through the musculature, so that in their numbers there is a compensation, so to speak, for their small size and lack of a multiplicity of heads. Inasmuch as the presence of these cysts calls for condemnation of a part or all of the infested carcass, according to the degree of infestation, and the number of carcasses amounts to 20,000 a year, this parasite has considerable economic interest for

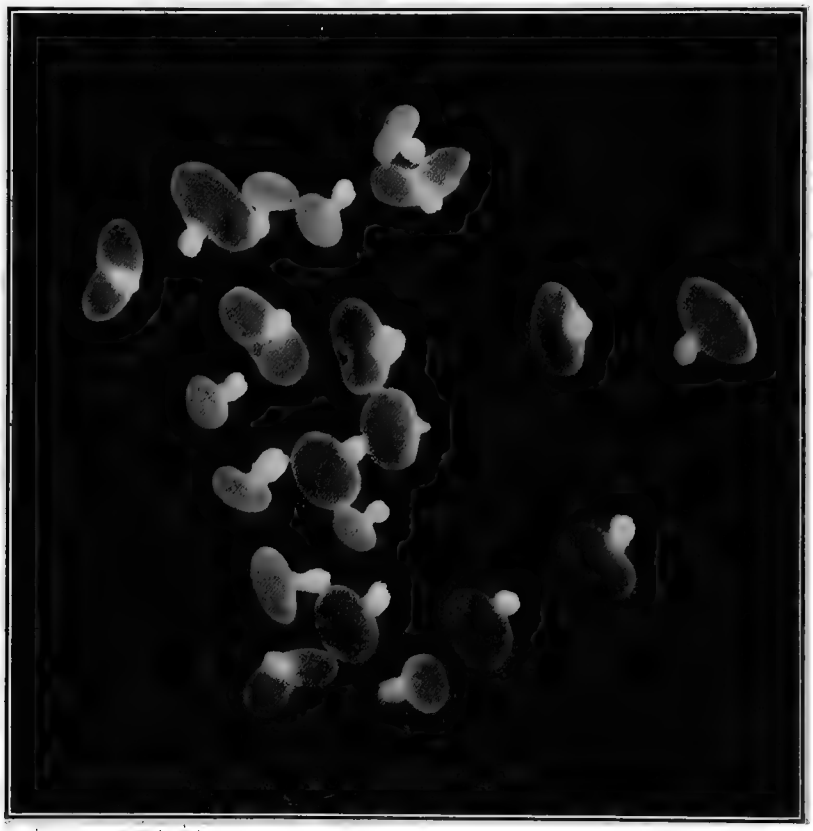

FIG. 6.—Bladder worm (*Cysticercus ovis*), a tapeworm cyst infesting the meat of sheep. (From Ransom.)

this country, and never more than at the present time when the "high cost of living" is such a vital topic.

When one of these cysticerci from mutton is ingested by a dog, the tapeworm head passes undigested to the dog's intestine and develops into a fairly large tapeworm, comparable to the gid tapeworm. Similarly, this tapeworm, *Tænia ovis* (fig. 7), produces eggs which are passed out in the feces of the dog, and which are ingested

by sheep as they graze over range or pasture or drink water contaminated by these feces. In the sheep the eggshell is digested, the released embryo bores through the tissues and comes to rest usually in the edible musculature, and the bladder worm develops to the cysticercus capable of again infecting the dog. In cases of heavy infestation sheep are liable to die in the course of two to three weeks, but as a rule the health is not perceptibly affected. Here, as in all similar cases, the parasite must pass from the dog to the sheep and from the sheep to the dog.

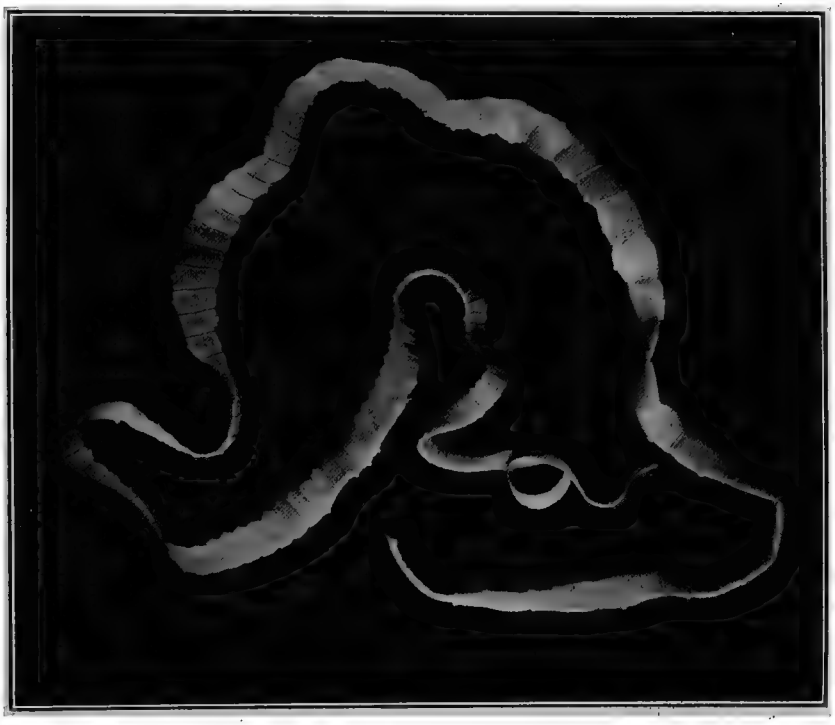

FIG. 7.—Tapeworm (*Tænia ovis*) developed by feeding bladder worm (*Cysticercus ovis*) to a dog. (From Ransom.)

The parasite has been found in Europe, Africa, and New Zealand. It has been found thus far in seven States in this country. It appears to be particularly prevalent in the West, a fact that is possibly related to carelessness on the part of the western sheepmen as regards the disposal of carcasses of sheep dying on the range. Such sheep are usually left lying where they die, a practice which aids in the spread and continuance of gid, and which serves the same purpose in the case of the "sheep measles" parasite that throwing diseased viscera of hogs onto the fields does in the case of the hydatid parasite. The sheep dog is probably the principal carrier of the parasite,

so that neglect on the part of sheep owners is a leading reason for its prevalence.

The prophylactic measures against "sheep measles" are essentially the same as those against gid and hydatid. Diseased portions of slaughtered sheep and dead sheep which have not been slaughtered should be cooked before being fed to dogs or else disposed of so that dogs can not eat them. Ownerless dogs should be destroyed and other dogs properly fed and kept free from tapeworm.

Muscular cysticercosis ("*measles*") *in reindeer.*—This parasite deserves special mention in view of the possibility that the Alaskan reindeer may become important in connection with the meat supply of this country. A large percentage of these animals, which are rapidly increasing in numbers, are infested with a measle parasite apparently the same as the form known to be the intermediate stage of a dog tapeworm (*Tænia krabbei*). This is not only serious so far as concerns the reindeer industry, but the possibility that the parasite may become established in other food animals is not altogether excluded, though probably remote. *Tænia krabbei* occurs in Europe and Asia and was likely introduced with the reindeer or dogs imported into Alaska, though the Alaskan form may be a native parasite already present in American reindeer and carnivores before the importation of the Old World animals.

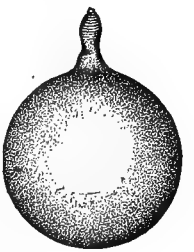

FIG. 8.—*Cysticercus tenuicollis*, the thin-necked bladder worm from the body cavity of cattle, sheep, swine, etc. Natural size (after Stiles).

Cysticercosis of livers and mesenteries.—Cysticercosis, or the presence of cysticerci, or bladder worms, in the livers, mesenteries, and omentum or "fat caul," is very common in cattle, sheep, and hogs throughout the United States. These bladder worms, *Cysticercus tenuicollis* (fig. 8), are usually 1 or 2 inches in diameter, and the cyst contains a single tapeworm head. The life history follows the same general plan that has been outlined for the preceding tapeworms. When such bladder worms, or viscera containing them, are eaten by dogs, the head contained in each cyst passes to the intestine and develops a tapeworm (*Tænia hydatigena* or *Tænia marginata*) (fig. 9) in the dog; the eggs produced by the tapeworm pass in the feces of the dog onto the vegetation or into the drinking water of cattle, sheep, and hogs; the eggs ingested by these animals in feeding or drinking release an embryo which makes its way, via the portal system, from the digestive tract to the liver; in the liver the embryo develops into a small bladder worm (*Cysticercus tenuicollis*) which after some time slips from the liver into the body cavity and lodges in the omentum or mesenteries, where it attains its final growth; the bladder worm may then be eaten by a dog, on the death of the host

animal in which the bladder worm occurred, and will give rise to a large tapeworm, which may attain a length of 5 meters, or about 16 feet.

Extensive burrowing of the parasites in the substance of the liver during the early period of the bladder-worm development may cause serious damage, and in cases of heavy infestation may result in the death of the animal. Bacterial infection may complicate the parasitic invasion. In the United States, flocks of sheep in which this parasite is not present are rare, and a high percentage of livers, especially lamb livers, are condemned in abattoirs under Government inspection because of infestation with this parasite.

Prevention calls for a proper disposal of the viscera of slaughtered animals with a view to keeping the viscera, unless first properly cooked, away from dogs. It also calls for a routine tapeworm treatment for dogs, an adequate knowledge and supervision of the food and feeding habits of dogs, and the elimination of the dog without a responsible owner.

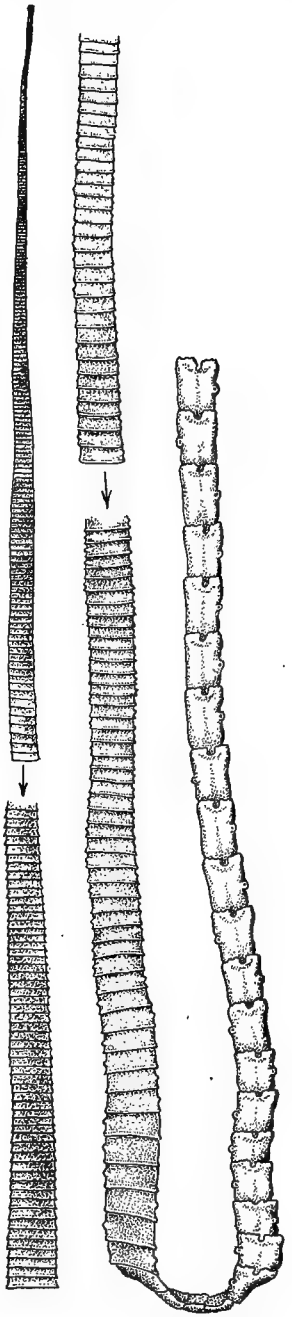

FIG. 9.—*Tænia hydatigena*, the adult tapeworm from the intestine of the dog. Natural size (after Stiles).

TAPEWORMS, ROUNDWORMS, ETC.

Double-pored tapeworm.—Of the numerous species of tapeworm occurring in the dog, many of them not mentioned in this paper because they do not have a larval stage or bladder worm in man or stock, one species may occur in man in the form of the adult tapeworm. This species, commonly known as the double-pored tapeworm (*Dipylidium caninum*), has a life history which follows the same general plan of alternation, from a tapeworm in the dog to a larval tapeworm in an intermediate host and back to the dog, that the tapeworms already mentioned follow. It is, however, peculiar in that the intermediate stage,

or larval tapeworm, is very small and develops in the dog flea or louse instead of such an animal as the sheep. The flea or louse ingests the eggs of the tapeworm by biting the skin of the dog where it is contaminated by the feces of the animal or by soil containing eggs from the feces, or possibly by biting the tapeworm segments containing the eggs as these segments pass from the dog. Within the flea or louse the egg develops into a larval tapeworm, necessarily a very small larva, known as a cryptocystis. Owing to the pain and irritation resulting from the bites of these fleas and lice, the dog will from time to time root out the offenders and inadvertently or intentionally, as the case may be, swallow them. In the stomach of the dog the fleas and lice are digested and the little tapeworm larva set free to pass on to the intestine and develop into a tapeworm, which may attain a length of 35 centimeters, or about 14 inches.

When flea-infested or lousy dogs are allowed unwarranted privileges in the house, permitted to put their paws on the table during meals, to eat from the same dinner plates and saucers, to lick the baby's face and the children's candy, to sleep at the foot of a person's bed or on a pillow near a person's head, the chance of a flea landing unperceived in food that will hold and conceal the flea, the chance of its getting to the baby's mouth or adhering to the sticky candy which the child eats with no regard to incidental contamination, is very good. Under such conditions the ingestion of fleas or lice infested with the larval tapeworm in question is likely to occur, and the result is the development of the adult tapeworm in the person ingesting them. This tapeworm has been found in children more frequently than in grown persons, in one case in a baby only two months old, but it has been found in an adult 38 years old. As many as 238 worms have been found in a single person. Up to date, 76 cases of this tapeworm in man, usually in children, have been reported, and a number of these are from the United States.

The remedy here concerns the family dog rather than the stray. The dog should be treated like a dog, not like a person. The dog is an animal with its habits fixed by all the facts that arise from the one fact that it is a dog. The fact that a dog is not a person, that it is different from people, is important. The lack of hands compels the dog to use his tongue for a wash rag, but we are under no such necessity, and there is nothing in the situation that calls for our permitting our own or our neighbor's dog to use the same tongue subsequently on our hands or face. It is an absurdity to ask that the cook and the table service be clean and then allow a dog to put his feet on the table, to sniff at the food, to lick the hand or face, and to

do the dozens of other dangerous and improper things that some dogs are allowed to do.

The presence of one or a few of these tapeworms in man probably occasions very little inconvenience as a rule. At the same time the tapeworm has an unpleasant habit of burrowing through the intestinal mucosa, thereby destroying its integrity and exposing it to the attack of any pathogenic germs that may be present in the intestine. The same burrowing habit makes it difficult to remove successfully the entire worm with the head, and a failure to remove the head, owing to its being buried in the mucous lining of the intestine, results in the subsequent development of new tapeworm segments from the head and a renewal of infection. At its best, a tapeworm is a thing unpleasant to contemplate as an inhabitant of our intestines. The presence of the tapeworm under discussion here is, moreover, evidence of careless or unclean habits on the part of the person infested.

Prevention requires that the unwarranted liberties and freedom of the dog be curtailed; that he be kept free not only from tapeworm but from such external parasites as fleas and lice. The accomplishment of the latter measure calls for keeping a dog clean and restraining him so that he will not be allowed to run at large with vagrant flea-infested and lousy dogs.

Roundworm.—Among the other parasites of the dog there is a nematode or roundworm, scientifically known as *Toxascaris limbata*, which, like the tapeworm just mentioned, may occur in man in the same form in which it occurs in the dog. This worm does not have an intermediate stage in another animal, but is conveyed directly through the eggs produced by the female worm, which eggs normally convey the infection from a dog back to the same or another dog, either in contaminated food or water or as the result of the contamination of the skin and the subsequent cleansing of the skin by means of the tongue.

Under the conditions of unwarranted association and familiarity with dogs already mentioned, eggs of this parasite and of an allied parasite in the cat may be ingested by man, and especially by children, and subsequently develop into the adult worm in the intestine. These worms may produce unpleasant results. The entire group of ascarids are notorious for their wandering habits. They not infrequently travel to the stomach and produce vomiting, in the course of which the worms may be brought up. It is hardly necessary to say that the vomiting of worms 4 or 5 inches long is a distinctly unpleasant experience, and this is one of the least unpleasant results

of such infestation. Ascarids at times enter the appendix and cause appendicitis; they may perforate the intestine and cause peritonitis; they may come up the esophagus and get down the windpipe, with a resultant suffocation, or enter the eustachian tube of the ear. These are unusual cases for the most part, but they are dangers to be considered. There are other unpleasant and dangerous features of ascarid infestation, and the uncomfortable certainty that their presence is undoubtedly indicative of fecal contamination of food, drink, or ingesta of some sort.

The prophylaxis in this case, as in the case of the previously mentioned worms, depends on keeping dogs free from worms and restricting their privileges in the household and in their relationship to human beings.

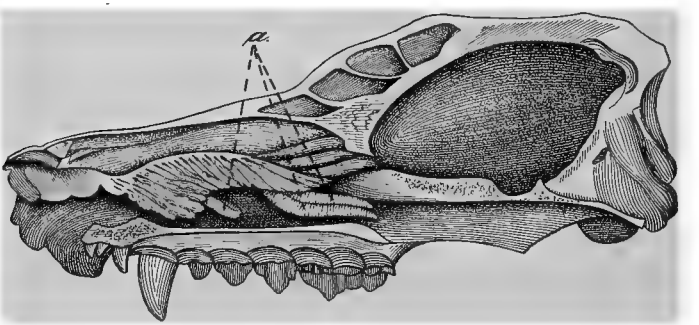

FIG. 10.—Head of a dog split in half to show three tongueworms (*Linguatula rhinaria*), *a*, in the nasal cavity. Reduced in size (after Colin).

Tongueworm.—The tongueworm, *Linguatula rhinaria* (*Linguatula serrata*) (fig. 10), occurs in the adult stage in the nasal passages and frontal sinuses of the dog. It is light colored and shows an external, ringlike segmentation. The male may attain a length of 20 millimeters (about three-fourths of an inch) and the female may attain a length of 100 millimeters (about 4 inches). The eggs deposited by the female leave the nostrils of the dog in the catarrhal secretion occasioned by the presence of the parasite, some of them doubtless being sneezed out, and contaminate the vegetation on which they at times lodge. Such vegetation may be eaten by cattle, sheep, horses, or swine, or if the infested dog has access to a truck garden or a family vegetable garden, contaminated lettuce, cabbage, etc., may be eaten by man. When the eggs get to the stomach the shell is digested off, releasing a peculiar embryo which shows by its structure that these tongueworms are really related to the mites, a group of spiderlike animals. This embryo makes its way through

the walls of the intestine and encysts in the lungs, liver, kidney, lymphatic glands, etc., where it develops to the larval stage (fig. 11). Subsequently they break out of their cysts and resume their migrations, wandering through the tissues, causing more or less damage, until they reach the abdominal or thoracic cavity, sometimes entering the intestines and bronchi, and at times causing the death of the host. Just how they get from here to the nasal passages of the dog is not very well known, though it is certain that this takes place. Possibly larvæ are at times sniffed up by the dogs as they nose through an infested carcass; possibly in eating such a carcass larvæ pass directly from the mouth of the dog back to the posterior portion of the nostril by way of the pharynx, or the parasite may return from the stomach by way of the esophagus. The adult worm has been reported, but very rarely, from the nasal passages of man.

The larvæ are apt to be overlooked in necropsies on the human cadaver, but have been recorded in as high as 25 per cent of necropsies. In various localities in Germany they are commonly present in 3 to 4 per cent. This is a widely distributed parasite, and is found from time to time in the United States. A case in man has been recorded from the Canal Zone.

Prevention consists in keeping viscera of animals away from dogs, unless the viscera are cooked, and in a reasonable attention to what a dog eats, and this involves a responsible supervision of the dog's wanderings and conduct in all respects.

FIG. 11.—*Linguatula rhinaria*, the larval tongueworm from the liver and lymph glands of cattle, sheep, etc. Enlarged ten times (after Railliet).

FLEAS AND TICKS.

Fleas.—In the western United States investigations indicate that the commonest flea attacking man is the so-called human flea, *Pulex irritans*, of which man is the primary host. The same investigations indicate that the dog is a most important carrier of that flea, probably the most important. Of 456 fleas collected from dogs in Berkeley, Cal., 29 per cent were of this species. In the eastern United States investigations indicate that the commonest flea attacking man is the so-called dog flea, *Ctenocephalus canis* (fig. 12), and here, of course, the dog is the normal host and the usual carrier.

Either species of flea constitutes an annoying pest. The bite is distinctly unpleasant and in the summer nights may prove just the

additional irritant which makes sleep impossible. Equally as important as the annoyance is the fact that fleas of all sorts are under suspicion at present as possible carriers of bacteria, parasites, and diseases of various sorts. We know that the dog flea and the human flea, as well as the rat flea, are capable of transmitting bubonic plague to man; that the dog flea, as already noted, transmits the tapeworm *Dipylidium caninum* to man; and we are warranted in suspecting that additional study will add other counts to this indictment against fleas. In the meantime our actual knowledge and strong suspicion are ample grounds for avoiding fleas and the flea-bearing

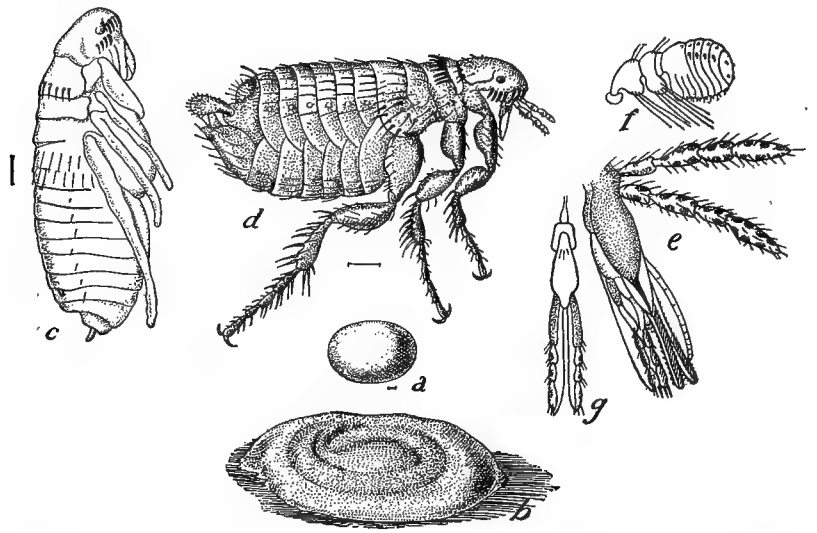

FIG. 12.—Dog flea (*Ctenocephalus canis*): *a*, Egg; *b*, larva in cocoon; *c*, pupa; *d*, adult; *e*, mouth-parts of same from side; *f*, antenna; *g*, labium from below. *b*, *c*, *d*, Much enlarged; *a*, *e*, *f*, *g*, more enlarged. (From Howard, Bureau of Entomology.)

dog. It is comparatively easy to avoid annoyance from fleas in the absence of dogs or cats around a dwelling. Where dogs and cats are present it is more difficult and the animals must be closely watched and given appropriate treatment from time to time. For adequate protection it is essential that stray dogs and dogs belonging in the neighborhood should be prevented from becoming habitual visitors and utilizing the porch and hammock as sleeping quarters.

The chicken flea (*Echidnophaga gallinacea*), a common pest in some of the Southern States, frequently infests dogs. Here, again, the remedies lie in the proper handling of dogs by their owners and the elimination of ownerless dogs or dogs whose irresponsible owners

take no care of them. Under proper conditions of restraint dogs may be rid of fleas and kept free from them.

Ticks.—In this country the dog is known to be the usual or occasional carrier of 11 species of ticks, almost all of which are also occasional or habitual parasites of man or stock. In this way the dog serves the tick by furnishing it with nourishment and also aids in spreading infestation, conveying ticks in this way to man much more effectively than other animals are able to do, for the reason that there is no other animal in such close contact with man, with so many liberties, and with such a wide and unrestrained range during the periods when it is not with its owner. These habits of the dog make it an object of suspicion in connection with tick-eradication work. Such ticks as *Dermacentor variabilis* (fig. 13), which are common on the dog, are brought into houses rather frequently and have many opportunities to attack man. Such ticks as the spotted-fever tick, known as *Dermacentor andersoni* or *Dermacentor venustus* (fig. 14), are seldom found on dogs, but in view of the fact that the bite of one tick may result in spotted fever and the death of the person bitten, even such infrequent transmission by dogs must be guarded against. This tick is known to occur in Montana, Wyoming, Colorado, New Mexico, and the States west of these, with the exception of Arizona. Spotted fever is known to occur in a number of these States, and with the tick present its occurrence and spread in the other States depend merely on the chance of a carrier of some sort coming into them under conditions which will permit of the tick having access to the carrier and to other animals or persons. Dogs may also carry the Texas-fever tick (*Margaropus annulatus*), and some species of ticks possibly depend on the dog for their continued existence.

FIG. 13.—American dog tick (*Dermacentor variabilis*); male, dorsal view. (From Hooker, Bishopp, and Wood, Bureau of Entomology.)

FIG. 14.—Rocky Mountain spotted-fever tick (*Dermacentor andersoni*, or *D. venustus*); male, dorsal view. (From Hooker, Bishopp, and Wood, Bureau of Entomology.)

Dogs which are kept free of such vermin as ticks by frequent baths or other necessary measures and which are not allowed to wander at will are reasonably safe from the standpoint of spotted fever or other tick conveyance to man or stock. They are at least much safer than those which are neglected, allowed to accumulate internal and external parasites, and to carry and convey the same without hindrance.

MISCELLANEOUS PARASITES.

In the foregoing part of this paper only those injuries, parasites, and diseases traceable to the dog which are known to occur in the United States have been mentioned. It should be stated, however, that the dog is known to have quite a large number of other parasites, some of them already present in this country, which have been found in man and stock in foreign countries, sometimes as rare and unusual occurrences and sometimes very common and even in the form of endemic, constantly present diseases. Inasmuch as almost all of the parasites heretofore mentioned originated in foreign countries and were brought here, and since we have no guaranty and but little protection against others being brought here, it will be worth while to name some of the other parasites of which space forbids a detailed discussion. Some of the parasites mentioned below have been found in the dog only as a result of experimental infestation, which is, however, proof that they might occur in nature under suitable conditions of transmission. Some of these diseases, owing to the nature of the life history, possibly could not obtain a foothold in this country, but many of them certainly could.

Protozoa.—The dog has been reported as a carrier of the following protozoa: *Entamœba dysenteriæ*, the cause of amebic dysentery in man; *Lamblia intestinalis*, a flagellate protozoan which is rather common in man in the United States; *Trypanosoma evansi*, which is the cause of surra, a disease of horses, cattle, etc., which has not yet been introduced into this country, but which has been detected at the quarantine station and kept out of the country by the United States Bureau of Animal Industry on one occasion; *Trypanosoma brucei*, which is the cause of nagana, a disease of horses, cattle, etc., which occurs in Africa; *Trypanosoma equinum*, which is the cause of mal de caderas, a disease of horses in South America; *Trypanosoma dimorphon*, which causes a disease of horses, cattle, etc., in Africa; *Trypanosoma pecaudi*, which is the cause of baléri, a disease of horses in Africa; *Nuttalia tropica*, which is the cause of a piroplasmosis of horses and cattle in India; *Leishmania furunculosa* (*L. tropica*), which is the cause of Oriental sore, a disease of man which has recently been reported from this continent at Panama;[1] *Leishmania*

[1] Oriental sore in Panama. By S. T. Darling. Arch. Int. Med., Chicago, v. 7, May, 1911, pp. 581–597.

infantum, which is the cause of infantile splenomegaly, a serious, commonly fatal disease of children in Italy and Tunis; *Leishmania donovani*, which is the cause of tropical splenomegaly, a serious disease of adults in India, China, and the Sudan; *Leishmania braziliensis*, which is the cause of a disease of man in South America; *Spirochæta aboriginalis*, which is the cause of granuloma inguinale in man in British Guinea and Australia; and of some other protozoan forms of which the record or the identity of the form in the dog with those in man or stock is still uncertain. A useful object lesson may be drawn from the fact that the destruction of stray dogs in one small island in Italy has resulted in a remarkable reduction in the prevalence of infantile splenomegaly in that locality. This terrible disease is apparently spread from dogs to children by fleas.

In addition to the above-mentioned protozoa there are a number of worm and arthropod parasites carried by the dog and attacking man or the domestic animals, which have not been discussed in the first part of this paper because of their absence from or comparative infrequency or unimportance in this country. A brief note of these forms is given here.

Tapeworms.—As regards tapeworms, the dog shares with man the responsibility for carrying the broad fish tapeworm, *Diphyllobothrium latum* (*Dibothriocephalus latus*), a tapeworm of considerable medical importance, which is known to be established in this country, and both carry an allied tapeworm, *Diphyllobothrium cordatum*. The dog is also an occasional host of the pork measle parasite (*Cysticercus cellulosæ*), the larvæ of one of the tapeworms of man. The dog becomes infested with this parasite by eating the feces of the human host of the tapeworm. It has also been shown to act as the host of an adult tapeworm having a *Sparganum* larva in the hog, and may be the host of other related tapeworms belonging to this group.

Flukes.—The dog is reported as the carrier of the following flukes: *Paragonimus kellicotti*, which occurs in the lungs, causing parasitic hemoptysis in hogs in this country; *Clonorchis sinensis* and *Clonorchis endemicus*, which occur in the liver of man and hogs in China and Japan; *Heterophyes heterophyes*, which occurs in the intestine of man in Japan and Egypt; *Dicrocœlium dendriticum* (*D. lanceatum*), which occurs in the bile ducts of man and of horses, cattle, sheep, hogs, etc., and which is common in various foreign countries, though not as yet known from the United States; *Schistosoma japonicum*, which occurs in the blood of man in Japan, China, the Philippines, and South Africa; *Opisthorchis felineus*, which occurs in the liver of man in Asia; and of *Opisthorchis noverca* and *Pseudamphistomum truncatum*, also parasites of man.

Nematodes.—As regards nematodes, the dog is one host of *Dracunculus medinensis*, the Guinea worm, which is not known in this

country, and is the usual host of *Dioctophyme renale*, the giant kidney worm, which is a huge red worm a yard long and as thick as a little finger, occurring in the kidney or abdominal cavity of man, the cow, the horse, and the hog. This last-named worm has been found in this country on a number of occasions. *Strongyloides stercoralis*, the parasite of Cochin China diarrhea, can be readily transmitted to dogs, and a *Strongyloides*, apparently this species, is found in dogs in China and Japan.

Mites, fleas, etc.—The dog is affected by a form of mange or scab due to a mite known as *Sarcoptes scabiei canis*. This disease occurs in this country and may be transmitted to man, causing more or less discomfort. The dog is also known to be attacked by and transmit the sarcoptic scab of sheep, a rather rare form of scab due to the mite *Sarcoptes scabiei ovis*.

In addition to being the adult host of the aberrant spiderlike form, *Linguatula rhinaria*, the larva of which may occur in man, the dog is a host for the larval form of two closely related species, *Porocephalus armillatus* and *P. moniliformis*, which may also pass their larval stage in man.

The dog is not only a host for the cosmopolitan fleas *Pulex irritans* and *Ctenocephalus canis*, but is also a host for the widely distributed chigger flea, or chigoe, *Dermatophilus penetrans* (*Sarcopsylla penetrans*), of tropical countries and native in the southern portion of North America. This flea attacks men, cattle, horses, mules, sheep, goats, and hogs, the female becoming embedded in the skin and growing to the size of a pea.

Finally, the dog is an important host of the parasitic larvæ of certain flies which also habitually attack human beings and live stock. One species, *Dermatobia cyaniventris*, occurs in South and Central America, and another, *Cordylobia anthropophaga*, occurs in Africa. These larvæ undergo their development beneath the skin, causing boil-like tumors and abscesses. Another species, *Paralucilia macellaria* (*Chrysomyia macellaria*), is a serious pest in the southern United States. Its larvæ, commonly called screw worms, attack cattle, horses, and other animals, including dogs and human beings. These screw worms may undergo their development in the carcasses of dead animals as well as in the tissues of live animals.

CONCLUSION.

The parasites discussed in this paper do not nearly exhaust the list of those present in the dog, but only those known also to affect man or live stock.

In conclusion it may be said that the dog is at present the subject of numerous criticisms from three quarters. For over half a century

parasitologists have been insisting that the dog is so largely responsible for the spread and so essential to the existence of so many important parasites that we must curtail his liberty and guard him, ourselves, our families, and our stock from the evil results of his unrestrained wanderings.

For a number of years public-health officers and others who have the welfare of the community at heart have been insisting on a restriction of the dog's unwarranted liberty in order to lessen and in time to eliminate the terrible menace of rabies.

More recently the sheepmen who have been accustomed to keeping out of business in localities where there were too many dogs, or who have permitted themselves to be forced out of business as a result of the attacks of sheep-killing dogs and the resentment and antagonism of the dogs' owners, have been taking more aggressive action and have started a propaganda looking toward the elimination of the worthless dog and the placing of full responsibility for other dogs on their owners.

It is to be hoped that the coordinate action of these persons and others interested in the safeguarding of life, health, and property will soon bring about positive and valuable results.

In a general way there are three kinds of dogs—the vagrant, ownerless stray; the other person's dog; and your own dog.

The stray dog which recognizes no owner must be eliminated. The irresponsible dog with no owner to care for him, to look after his health as it concerns the dog and other animals and man, and to restrain him and stand sponsor for his acts and especially the damage he may do—such a dog does not fit into a scheme of civilization which is based on law and the responsibility of individuals for themselves and others.

We have a right to insist, and should insist, that the other person's dog keep off our premises. A dog that is allowed by the owner to wander at large will have substantially the same habits of life, the same sort of food, and be substantially as dangerous as the ownerless dog. Such a dog is not only a trespasser but a potential menace whose visits may incur loss of money, health, or even life.

Your own dog should be handled in such a way as best to further the welfare of the dog and the community. He should be kept in restraint and not allowed the full freedom of the house or even of the outside premises. He should not be allowed to be familiar with people, and especially with children. The dog should be kept free from external parasites by frequent baths and, if necessary, other appropriate measures, and should be freed from internal parasites by suitable measures and kept free by adequate attention to his food. He should only be allowed to leave the yard or the kennels in company

with some person, and wherever conditions call for it should be kept in leash. When away from home the dog should be muzzled with a reliable metal muzzle, not with a strap muzzle that would be cruel to the dog if tight enough to be effective and which is usually so loose as merely to give a false sense of security, since it permits the dog to bite.

In regard to laws requiring muzzling and other restraints, Schroeder[1] has made the following interesting comment:

> The reason why laws of this nature have not been made is due to the active fight against them by a small, greatly interested minority that opposes a tardy, disinterested majority. The minority fights hard for a privilege it has long enjoyed and abused, that of allowing dogs to be at large without restraint at all times, and the majority has never half realized that this privilege is costing a high price in the destruction of property and in horrible agony and numerous deaths. * * * The dog owner who knows what rabies is from experience, if he has the proper consideration for his own welfare and that of his dogs, will be among the first to demand a movement for its suppression, even if this should place restrictions on the freedom of his own dogs. His interest is greatest because he has the most at stake and is himself most seriously and frequently exposed to the infection.

As means or adjuncts for attaining the conditions outlined here, numerous measures have been suggested and, to some extent, practiced in this country. Some of these measures are cited in a paper by Stimson,[2] and a very good summary has been given by him. Among the possible measures are, of course, the imposition of a license on all dogs, dogs so licensed to wear an official tag with at least a registered serial number on it, and possibly with the owner's name and address also. Any dog not so licensed should be taken up by an adequate impounding force and humanely killed. Dogs so licensed should be taken up when found astray in violation of ordinances requiring muzzling or imposing other restrictions. Rabies should be made a reportable disease everywhere, and prompt and thorough measures taken for its eradication, to be followed by quarantine against unrestricted importation of dogs into clean areas. Castration and spaying are recommended as aids in keeping a dog at home. They also serve to stop the promiscuous breeding which serves to add recruits to the vast army of worthless and vagrant dogs. Dr. Arbuckle, in recommending castration, says that it does not diminish the animal's value as a hunting dog.

Protection from the dangers of improperly controlled dogs depends primarily on the education of the public and the development of an educated public sentiment. With public sentiment behind it any re-

[1] Some observations on rabies. By E. C. Schroeder. Bureau of Animal Industry Circular 120. 1908.

[2] Facts and problems of rabies. By A. M. Stimson. Hygienic Laboratory Bulletin 65, 1910.

form is possible; without it practically nothing is possible. Undue sentiment for the dog should not be allowed to blind us to his dangerous possibilities as a carrier of diseases and parasites or to stand in the way of effective measures for the protection of human life and health. The time seems to be at hand when the stray dog, the sheep-killing cur, the vagrant carrier of dangerous parasites and of the horrors of rabies should be exterminated. The destruction of such dogs would mean a saving of hundreds of lives and the saving and making of millions of dollars.

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PARASITES AND PARASITIC DISEASES OF DOGS[1]

By MAURICE C. HALL, *chief*, EMMETT W. PRICE, *parasitologist*, and WILLARD H. WRIGHT, *associate veterinarian, Zoological Division, Bureau of Animal Industry*

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IMPORTANCE OF PARASITE CONTROL

The parasitic diseases of dogs and cats rank in importance with the bacterial diseases affecting these animals. No such provisions exist for collecting statistics on diseases of animals as there are for collecting statistics on diseases of man, so it is not possible to make such close approximations as to prevalence of disease in veterinary medicine as in human medicine. But conceding first place to distemper, that almost universal scourge of dogs with its mortality commonly estimated by veterinarians at about 50 percent, the various forms of mange are probably entitled to a second position, with a group of worm infestations following in importance. Worm infestations, especially roundworm and hookworm infestations, are especially prevalent and deadly in puppyhood and most so in tropical and subtropical countries, although by no means unimportant in temperate zones. There are a large number of worm parasites and of external parasites, such as insects and ticks, reported from dogs and cats, but only a few of the more important ones are considered here.

The importance of these parasites, especially those of dogs, is heightened by the fact that a number of them are transmissible in some form to man and to livestock. A number which occur as adults in the digestive tract of the dog also occur in the same form and in the same place in man. In addition dogs have a number of adult parasites which occur as larval or immature parasites in man

[1] This circular, as revised, includes information on parasites affecting cats.

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and livestock, including the deadly hydatid with a mortality of about 50 percent for human patients in cases not operated on, various other tapeworms which have their larvae (bladderworms) in cattle, sheep, goats, swine, reindeer, etc., and tongueworm, with both adult and larval stages occurring in man and livestock. Finally, dogs carry such parasites as fleas, which attack both man and dogs, and transmit sarcoptic mange to other dogs and to man. In many cases the annoying prevalence of fleas in houses is directly due to flea-infested dogs.

The control of parasites in the dog is therefore necessary and desirable not only for the sake of the dog but for the sake of human health and the welfare of the livestock industry. This control is of two sorts. One method of control is that of prophylaxis or prevention of parasitic infestation and disease, and the other is that of medicinal treatment where parasitism is actually present in the absence of preventive measures or in spite of them.

Prevention is the business and duty of the dog owner. It is largely a matter of sanitation and careful supervision of the dog's habits, especially his food habits. Dogs usually become infested with parasites in one of two ways:

(1) By being in contact with infested premises or infested animals. Dogs transmit their fleas and lice to one another and transmit their fleas to man and also infect the premises with flea eggs and larvae, thus giving rise to adult fleas which attack the first human or canine victim that comes in reach. Worm eggs pass in the feces (excrement) of the dog and develop to the stage where the eggs or the larval worms hatching from them will infect dogs or persons, infection sometimes taking place as a result of swallowing the eggs or larval worms in contaminated food or water, and sometimes as a result of the larval worms burrowing through the skin when it is in contact with contaminated soil.

(2) Dogs become infested with parasites by eating raw or insufficiently cooked meat, neglected carcasses, discarded viscera, or raw fish containing the larvae of worms. Such larval worms include the bladderworms occurring in the viscera of cattle, sheep, goats, swine, and rabbits. It is the duty of the owner to see that premises are kept clean, that the excrement is removed frequently and thoroughly, that dogs eat only suitable and safe food, and that dogs are bathed and kept clean and free from vermin of all sorts. This involves supervision of the dog's habits to the extent of not allowing the animal to run at large under conditions that permit it to eat whatever carcasses it may find or whatever animals it may kill. The dog that eats offal at the country slaughterhouse or kills and eats rabbits is practically certain to become infested with tapeworms. Slaughterhouse offal is probably the most important source of infestation of dogs with hydatid tapeworm, a menace alike to the owner of the dog, his family, and his livestock. The neglected dog running at large collects fleas and lice and contracts mange to an extent not possible to the dog that is properly cared for and supervised.

Medicinal treatment is the business of the veterinarian, not of the dog or cat owner. It involves an accurate diagnosis, a matter that calls for special training, medical skill, and adequate experience, things which the dog or cat owner is not likely to possess. Errors in diagnosis mean misdirected efforts, with the possibility of injury to the sick animal, loss of time and money, and the possibility that this lost

time will allow the real condition to go unrecognized until it is too late to save the animal. Treatment also involves the use of highly potent drugs, carefully selected with due regard to the end to be accomplished, and administered in such doses and in such a way as to cure disease without injuring the patient. The possible contraindications for treatment, conditions which make it evident that certain drugs or doses are dangerous, must be ascertained and kept in mind. The anthelmintics (drugs used to remove worms) are always poisonous, being intended to poison the worms, and must be given in such doses as will accomplish that object without materially injuring the patient. Insecticides injudiciously applied to the skin to kill parasites may injure the skin or kill the patient. In this discussion of parasites a number of treatments are described, since it may be necessary for an owner to treat his dogs or cats, when the services of a competent veterinarian are not available. It is understood, of course, that an owner gives such treatment at his own risk and that he assumes the responsibility for his diagnosis, selection of drugs, dosage, method of administration and technic, and the risk of possible bad results. Each animal presents his own special individual case, and no general directions can cover all of the possibilities. Passing judgment on the individual case is precisely where the skilled veterinarian becomes indispensable, and whenever possible he should be employed.

EXTERNAL PARASITES AND PARASITIC SKIN DISEASES

MANGE

The dog suffers from mange of three sorts—sarcoptic mange, ear mange, and demodectic mange, whereas cats usually are affected only by the sarcoptic type. Sarcoptic mange in dogs occurs over the body and is characterized by the formation of crusts or scabs in advanced stages of the disease; this form of mange in cats is usually restricted to the head and neck. Ear mange, as the name implies, occurs in the ears. Demodectic mange, also called red mange or follicular mange, occurs over the body and is characterized by a falling out of the hair and frequently a reddening of the skin in the early stages, the condition commonly progressing to the formation of pustules. In this disease and in sarcoptic mange there is a characteristic unpleasant "mousy" odor.

CANINE SARCOPTIC MANGE

Cause.—Canine sarcoptic mange is due to the canine sarcoptic mange mite, *Sarcoptes scabiei canis*, a form related to the spiders. This mite is very small, the largest specimen being less than one-fiftieth inch long. The general appearance under the microscope is that shown in figure 1. The sarcoptic mites, this form and its near relatives, have very short hind legs, not projecting beyond the margin of the body. When a dog is suspected of having mange, a portion of the diseased skin should be scraped with a dull knife and the scraping examined for mites. The scraping must be deep enough to draw blood, as these mites burrow deep into the skin, and it may be necessary to make scrapings from several areas. The scrapings should be softened by soaking in a solution of caustic soda or caustic potash for half an hour or more, the strong solutions acting more rapidly than weak ones, and then placed on a glass slide under a cover glass and

examined with the low powers of the microscope. Whenever possible this examination should be made by a competent veterinarian or zoologist, as these mites are frequently difficult to detect. The finding of the mites is sufficient to confirm the diagnosis of mange, but failure to find mites, while it establishes a presumption that the disease is not mange, does not prove the case, as the mites may be overlooked or not reached by the scraping.

Symptoms.—Sarcoptic mange affects dogs of all ages and all breeds. It usually begins about the head and may spread over the entire body in the course of a month. It appears first in the form of red points which soon become papules or vesicles, most easily seen where the skin is thin and without pigment, as on the abdomen. As the mite burrows into the skin it causes irritation and there is an exudate of serum. As this constant flow of serum dries it forms the characteristic scab. Simultaneously this irritation gives rise to itching, which becomes intense in the presence of heat or after exercise, and the animal scratches and rubs the affected portions of the body. In doing so it rubs off the scabs and opens up sores. Bacterial infection of these areas may add to the inflammation and injury resulting from the presence of the mite and the scratching. The hair also may become matted and fall out. There is evidently more or less toxic absorption from the mites or from the diseased skin, as shown by a blood reaction in the form of an eosinophilia, a condition frequently associated with parasitism, and the presence of the toxins and the loss of nervous energy due to constant itching and irritation cause the animal to become weak and thin. The skin may show large sores, and the mangy or "mousy" odor becomes very pronounced. A general impairment of digestion and other body activities follows and if the disease goes unchecked the animal dies, usually in 2 or 3 months under conditions favorable to the disease. The term "mangy dog" as an expression of reproach shows the general appreciation of the extremely pitiable condition and apparent worthlessness of such an animal.

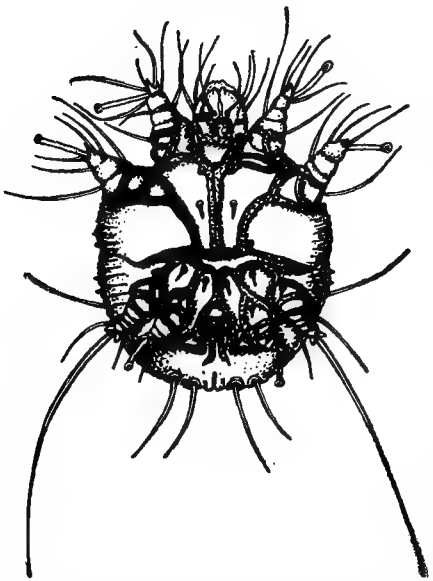

FIGURE 1.—The canine sarcoptic mange mite, *Sarcoptes scabiei canis*. Ventral view. Female. Enlarged. From Fiebiger, after Fuerstenberg. (Micron measurements: Male, 190 to 250 long by 140 to 180 wide; female, 290 to 450 long by 230 to 350 wide.)

Treatment.—A great aid in the treatment of mange is the use of such measures as will build up the general health and resistance of the animal. The dog should receive plenty of good nourishing food, including a supply of meat suited to the animal's condition and the amount of exercise it can take. Exercise and fresh air are important. Delafond and Bourguinon have recorded the cure of sarcoptic mange in the dog by suitable diet, exercise, fresh air, and hygienic measures,

even in an advanced stage of the disease. It is well known that susceptibility to mange and scabies in various animals depends in part on the general condition of the animal and on weather conditions. Mange in horses and scabies in cattle are much more prevalent in winter than in summer and more so among animals poorly fed and cared for than among animals well fed and cared for. On the other hand, it is reported that dogs in Greenland suffer from mange in the summer, the disease becoming latent or cured in winter.

In addition to hygienic measures, various treatments may be used to destroy the mange mites and cure the disease. Among the many treatments which have been used and recommended, a few are noted here.

The hair over the diseased portions of the body should be clipped, and it is usually advisable to clip it over the entire body. The hair may cover up evidence of areas in early stages of mange, from which areas the disease may spread after apparent cure of evidently diseased areas, and the removal of the hair simplifies treatment and makes it possible to use smaller amounts of medicinal substances effectively. The crusts present may be rubbed with green soap to soften them and an hour or two later the soap and crusts removed with a brush and warm water. The next day the application of substances intended to destroy the mites is begun by treating one fourth of the body, a different quarter being treated each successive day, so that the entire body is treated in the course of 4 days. The applications to each quarter are rubbed in thoroughly, left on for about 4 days, and then removed with warm water and soap. After each course of treatment the applications are omitted for 3 or 4 days and then repeated until the skin is healed and the itching and irritation have disappeared. One application that may be used consists of 1 part each of oil of tar and green soap in 1 to 5 parts of alcohol. Another is 1 part each by volume of oil of tar and crude petroleum oil, and 6 parts of liquid petrolatum. Another is cresol liniment, consisting of 2 parts aqua cresolis and 1 part each of soft soap and alcohol. Another is sublimed sulphur 2 parts, oil of tar 1 part, potassium carbonate 1 part, and lard 8 parts. Another is an ointment, consisting of sublimed sulphur 150 grams, potassium carbonate 8 grams, and lard 60 grams. Another is flowers of sulphur 1 part, tincture of iodine 1 part, oil of tar 8 parts, and olive oil 8 parts. Ordinary sulphur ointment, 1 part sulphur to 8 parts lard, may be used; to this may be added 1 dram of balsam of Peru. The ordinary lime-sulphur dips may be used. The animals should be prevented from licking the applications, by the use of a muzzle, broad collar, or some other means.

During the period of treatment the bowels must be kept open by the use of castor oil or Glauber's salt, daily, if necessary. The animals must be protected from cold. All diseased animals should be isolated for their own benefit and for the protection of those not diseased. It should also be kept in mind that sarcoptic mange of the dog is transmissible to man and that due precautions should accordingly be taken in handling mangy animals. The disease is also transmissible to the horse. Mange is a debilitating disease, leaving the patient more susceptible to various other diseases, and mangy animals are poor subjects for treatments to remove worms, being weakened to the point where they are much more liable to

succumb to the toxic effects of such anthelmintics as chenopodium than are animals without such complications as mange.

In connection with treatment, one must remember that the premises used by mangy dogs are infected and that disinfection is therefore necessary. So far as possible, litter of all sorts should be burned. Kennels and other constructions should be thoroughly cleaned and then disinfected with hot, strong coal-tar disinfectants.

FELINE SARCOPTIC OR NOTOEDRIC MANGE

Cause.—Sarcoptic or notoedric mange in cats is due to the presence of a mite, *Notoedres cati*, which is smaller than the sarcoptic mite of dogs; it may be distinguished on microscopic examination from the sarcoptic mite of the dog by reference to figure 2. This form of mange is transmissible to dogs, and this possibility should be kept in mind where dogs and cats are associated. This type of mange is also communicable to man.

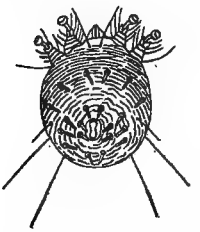

FIGURE 2.—The feline sarcoptic mange mite, *Notoedres cati*. Female. Dorsal view. Enlarged. From Gedoelst, 1922, after Mégnin. (Micron measurements: Male, 145 to 150 long by 120 to 125 wide; female, 245 to 280 long by 165 to 175 wide.)

Symptoms.—The mites usually attack the skin of the neck, ears, and face, and in severe cases the entire head and neck may be affected. The initial lesion is in the form of a small vesicle which is about the size of a pinhead. The vesicles later become confluent and crusts are formed. The hair becomes matted and may fall out. Itching varies in intensity in individual animals. As the disease progresses the animal presents a dejected appearance, and death may occur in from 4 to 6 months. In dogs this type of mange is confined usually to the head.

Treatment.—Coal-tar preparations and other preparations containing phenol should not be used in the treatment of mange in cats, as cats are particularly susceptible to poisoning with such compounds. An ointment composed of 1 part sulphur to 8 parts lard or equal parts of olive oil or cottonseed oil has been found effective in many cases. Helmerich's ointment, composed of sublimed sulphur 150 grams, potassium carbonate 8 grams, and lard 60 grams, has been recommended. A mixture of balsam of Peru 1 dram, and sulphur ointment 1 ounce, may be used but care should be taken not to apply this preparation over too extensive an area of the skin, as poisoning may result. As in the case of dogs, the hair should be slipped over the affected areas and the scales softened with green coap before the application of mange remedies.

EAR MANGE

Cause.—Ear mange is due to a mite, *Otodectes cynotis*, which is slightly larger than the canine sarcoptic mite. Owing to their size and the fact that they do not burrow, it is often possible to see these mites (fig. 3) with the naked eye, either in the ear or in detritus removed from the ear, the mites appearing as small white objects moving slowly about.

Symptoms.—These mites puncture the tissues forming the external canal of the ear and feed on the serum, causing an irritation which, among other things, interferes with the normal production and disposal of earwax. As a result the ear canal may become filled with detritus, consisting of more or less modified earwax and inflammatory products in the form of scales or powder. The mites appear to begin operations in the region of the eardrum, but as they multiply the canal becomes more or less filled with the mites, frass, wax, and scales. The mites alone cause a mild irritation and a pronounced itching, but the itching causes the dog to scratch and rub its ears and shake its head, and these activities on the part of the dog give rise to scratches, sores, and bleeding. Affected dogs frequently whine or howl, and in severe cases may show epileptiform spasms, travel in a circle, or show other evidences of nervous disturbances. More or less deafness may follow from the plugging of the ears and from injuries to them. Bacterial complications may follow, and inflammation of the middle and the inner ear and even of the brain is said to occur in rare instances. The condition may be diagnosed by carefully removing some of the material from the ears and finding mites in it by examination with the naked eye, a hand lens, or a microscope, or in earlier stages by recovering these mites by carefully swabbing the region of the eardrum with a pledget of cotton moistened with a bland oil, or by examining the ears with a speculum or otoscope in a good light with suitable illumination.

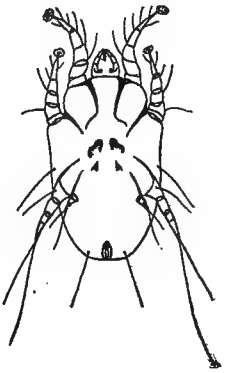

FIGURE 3.—The ear mite, *Otodectes cynotis*. Female. Ventral view. Enlarged. From Banks, 1915. (Micron measurements: Male, 350 to 380 long by 250 to 280 wide; female 340 to 530 long by 210 to 350 wide.)

Treatment.—Treatment for ear mange is not especially difficult. If the ear is full of detritus, this should be removed with forceps or a swab, taking care not to injure the eardrum. The ear canal can then be liberally swabbed with a cotton pledget soaked in one of the following preparations: 1 percent carbolic acid or creosote in glycerin; 5 percent carbolic acid in olive oil or castor oil; 1 part carbon tetrachloride and 3 parts castor oil; or 1 part chloroform in 9 parts olive oil or castor oil. Repeat treatment daily until the animal is cured.

FIGURE 4.—The demodectic mange mite, *Demodex canis*. Female. Ventral view. Enlarged. From Hirst, 1919. (Micron measurements: Male, 220 to 250 long by 45 wide; female, 180 to 300 long by 45 to 55 wide.)

DEMODECTIC MANGE

Cause.—The mites, *Demodex canis* (synonym, *D. folliculorum* var. *canis*), responsible for demodectic mange, differ materially in form from those already described, being elongated, vermiform objects (fig. 4). They are very small and can be detected only by the aid of the microscope. The diagnosis of demodectic mange (follicular mange or red mange) may be made by finding the mites in scrapings. The scrapings must be deep enough to draw blood, as the mites live down in the hair follicles. The scrapings may be macerated in caustic and

examined, the procedure being as given for the diagnosis of sarcoptic mange.

Symptoms.—Demodectic mange may occur in dogs of all ages and breeds but appears to be more common in young animals and short-haired breeds. The first evidence of demodectic mange, as a rule, consists in the appearance of hairless spots, often somewhat reddened, these spots commonly occurring about the eyes or at the elbows and hocks, though they may appear first in other places. There is very little itching at this time, and though itching may be more evident later there is usually less of it than in cases of sarcoptic mange, and when present it is usually intermittent. As the disease progresses the hairless areas become more extensive and redder,

FIGURE 5.—Dog with demodectic mange, depilatory form.

though later the skin may be lead gray in color. This is the so-called depilatory stage of the disease (fig. 5). At this stage the mites are increasing in the hair follicles, and the visible skin changes are evidences of inflammatory conditions about the follicles and their sebaceous glands. As many as 200 mites may occur in a single hair follicle.

Usually the depilatory form of demodectic mange, due to the uncomplicated cases of mite infestation as described above, becomes complicated in time through the invasion of the weakened and diseased skin by pus-forming bacteria, and sometimes these complications appear to be present from the onset of the disease. This condition is the pustular stage of the disease (fig. 6) and in this stage the previously hairless and reddened areas now show numerous pustules. In and under the skin there are numerous abscesses or pus

pockets, local destruction of the true skin or dermis takes place, and, according to some investigators, some mites now wander out of the hair follicles and may even enter the subcutaneous tissues. The numerous pustules run together and the skin becomes thickened and so seriously weakened from disease that it is highly susceptible to injury from rubbing or contact with various objects. The odor is very unpleasant. There is little or no itching in this stage. The absorption of toxic products from bacteria and diseased skin tissue serves to poison the entire system; bacteria may enter the blood stream, causing generalized infection; the bodily functions are deranged; the animal becomes emaciated and weak, and unless the disease is checked the dog dies in a very pitiable condition.

The disease usually runs a very slow course, commonly for months, and sometimes up to 2 years or longer. In rare cases there is spontaneous cure.

Treatment.—The subject of treatment for demodectic mange is still a controversial matter. Some competent veterinarians report a large measure of success in treating this disease, but others find treatment generally unsatisfactory and will not undertake it. In advanced cases of pustular mange destruction of the animals is commonly recommended. In general, the treatment of such cases is such a long, costly, and tedious affair, and so often ends in failure to obtain a cure, that the owners of the dogs are dissatisfied. This is especially true because dogs usually are not brought in for treatment until the disease reaches the pustular stage. After a few experiences of this sort the veterinarian prefers to avoid trouble with his clients and the presence of such unpleasant and unprofitable patients. When the treatment is left to the owner it frequently happens that he wearies of carrying out the prolonged treatment, forgets it from time to time or finds it inconvenient to attend to it, or neglects details and thoroughness. Even if he carries it out conscientiously, failure to cure is not an uncommon result, as much depends, apparently, on the condition and resistance of the individual animal. The senior author cured one case of extensive simple depilatory mange in a dog by the daily application of a mixture of olive oil 100 cubic centimeters, chloroform 30 cubic centimeters, and thymol 5 grams, but it required 100 treatments. In spite of sentimental considerations, few dog owners would care to carry out a treatment of this magnitude, especially in view of the fact that failure would

FIGURE 6.—Dog with demodectic mange, pustular form.

follow in some cases. In general, treatment should be begun early. The disease is more curable in the depilatory and localized cases than in the pustular and generalized cases.

The animal should be clipped before treatment is begun. Of the treatments which have been recommended, one which has the merit of simplicity and safety and is recommended as very effective, consists in the daily application of castor oil to and around the diseased areas. Whatever is used should be throroughly rubbed into the skin, not neglecting its application between the toes if needed. Liquid oil of tar has given good results in some cases and failed in others. Another treatment consists in the application to one fourth of the body daily, as directed for sarcoptic mange, of an ointment consisting of liquid phenol 1 part, camphor 2 parts, and white petrolatum 6 parts, the dog being bathed on the fifth day in a 2-percent solution of sulphurated potassa, and the treatment begun again the following day and continued as long as necessary. Another treatment which is variously recommended as a cure for demodectic mange or for the inflammation of the skin accompanying it, consists in the daily application of Lassar's paste, which is salicylic acid 2 parts, starch 24 parts, zinc oxide 24 parts, and white petrolatum 50 parts. Another treatment consists in the use of a 1- to 5-percent formaldehyde solution; the dog is dipped in this or liberally sponged with it, the dog's eyes being protected, and the animal then coated with sulphur ointment or petrolatum. This treatment is repeated every 3 or 4 days until 4 or 5 treatments have been given, the ointment being removed before each formaldehyde bath. One objection to the use of formaldehyde is that it is painful, having a sting comparable to that of the formic acid of an ant bite. A treatment which has been recommended widely consists in the use, once a week, of the following preparation: Kerosene 8 ounces, raw linseed oil 8 ounces, carbolic acid 1 ounce, oil of tar 1 ounce, and sulphur one-fourth pound; this is applied with mild rubbing. Good results have been reported in some cases of demodectic mange following the daily application of a 1-percent solution of rotenone. The solution is made up by dissolving 1 gram of rotenone in 10 cubic centimeters of acetone and then adding 50 cubic centimeters of alcohol and 40 cubic centimeters of distilled water. The solution should be shaken before use.

In connection with any medicinal treatment, the supplementary measures noted under the subject of sarcoptic mange should be used. In addition, the treatment of the pustular type of demodectic mange should be begun by opening the pustules with a sharp knife and squeezing out the pus. Under some conditions it has been recommended that the skin be scarified and treated with tincture of iodine, but this procedure should be left to the judgment of the veterinarian and carried out by him. Dogs are fairly susceptible to iodine poisoning. The pustular stage of mange is said to be greatly benefited in some cases by the injection of autogenous bacterins or stock polyvalent bacterins of streptococcic and staphylococcic bacteria of strains isolated from cases of demodectic mange, but the use of these bacterins should be left to the veterinarian. Arsenic, in the form of Fowler's solution, and sulphur are sometimes given internally for their effects on the system. Violet rays and even X-rays have been used in demodectic mange, and good results reported in some cases.

CHIGGER INFESTATION

Cause.—The common American chigger, *Trombicula irritans* (also called harvest mite), is a small, red or orange-yellow mite (fig. 7) which as a six-legged larva (the adult mite has eight legs) attacks man and the domesticated animals. It occurs from New York to central Mexico and from the Atlantic Ocean to the Rocky Mountains. A very closely relates species occurs in the northern and western part of this country. Chiggers have been thought to burrow into the skin and die there, but recent investigations indicate that they do not burrow, but merely attach by the mouth parts, and if left alone become engorged and fall off.

Symptoms.—Chiggers cause intense itching and this results in scratching and rubbing which in turn often result in the formation of sores with subsequent bacterial infection. Hunting dogs are especially subject to attack, owing to exposure as they range over chigger-infested territory. The chiggers attach most often about the head, feet, and belly, causing scattering eruptions which may contain pus. Chiggers usually attach singly, but a dozen or so sometimes attach at one point. Under favorable conditions they may be seen with a hand lens, but as a rule chigger infestation in dogs or cats would be suspected from signs of itching coupled with a history of chigger attacks on man at the same time and in the same vicinity.

FIGURE 7.—The common American chigger, *Trombicula irritans*. Enlarged. From Ewing and Hartzell, 1918, after Oudemans. (Micron measurements: Newly hatched larva, 330 long by 160 wide. Engorged larva, 1.5 mm long by 320 microns wide. Measurements by H. E. Ewing.)

Treatment.—Sulphur ointment will destroy chiggers at the point of attachment and in some cases appears to have a favorable effect on infected sores due to scratching the places attacked by chiggers. Alcohol in free and repeated applications is also good. Solutions of coal-tar creosote dips, in the strengths recommended on the labels for dipping or washing dogs, may be used. Ammonia, sodium bicarbonate, or dilute tincture of iodine serves to alleviate the itching.

Flowers of sulphur has been found of value in preventing attacks on man by chiggers, and it is probable that it would be of value in protecting dogs or cats if dusted into the hair. The coal-tar creosote dips would doubtless be of value for the same purpose. Such dips should not be used for cats. Oil of tar or fish oil, applied diluted with alcohol, would probably be repellent but objectionably messy. The cultivation of ground and the clearing away of underbrush and rank vegetation aid in keeping down chiggers.

TICK INFESTATION

Cause.—Various species of ticks will attack dogs and about 14 species have been reported from the dog in North America. The more important of these in the United States are the American dog tick or wood tick, *Dermacentor variabilis*, and the brown dog tick, *Rhipicephalus sanguineus;* these ticks rarely occur on cats.

The American dog tick (fig. 8) usually occurs as an adult tick on dogs, the earlier stages (those of seed tick and nymph) occurring on various small mammals. It attaches to various parts of the body, but displays a preference for the ears. When fully engorged with blood the female tick is almost half an inch long and of a bluish color, with a reddish-brown shield with white markings on the back near the head. This species occurs in the eastern half of the United States, in parts of the west coast, and occasionally elsewhere in this country.

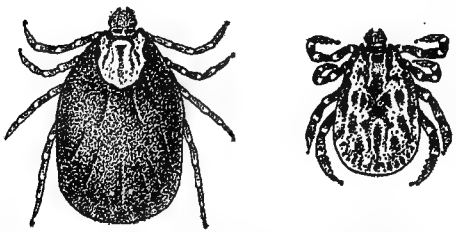

FIGURE 8.—The American dog tick or wood tick, *Dermacentor variabilis*. Left, engorged female; right, male. Dorsal views. Enlarged. From Banks, 1908.

The brown dog tick (fig. 9) occurs on dogs as seed tick, nymph, and adult. It frequently attaches inside a dog's ears, sometimes deep in the ear canal. The young ticks are likely to be abundant in the long hair on the neck, but any stage may occur on almost any part of the body, including the spaces between the toes. In this country this tick occurs in the South, being reported from Texas, Louisiana, Mississippi, and Florida, but it may be found farther north, being reported from Ohio, Pennsylvania, and New York. Its occurrence in these Northern States is due, no doubt, to the fact that dog owners have transported ticky dogs, mostly hunting dogs, from the South to the Northern States. It appears to have taken up the habit of living indoors over winter as an adaptation to cold winters, and according to F. C. Bishopp, of the Bureau of Entomology, and reports from various persons, causes serious trouble by establishing itself in kennels and about houses.

FIGURE 9.—The brown dog tick, *Rhipicephalus sanguineus*: *A*, Male; *B*, unengorged female. Enlarged. From McIntosh, 1931.

Symptoms.—Ticks cause local irritation at points of attachment, and dogs commonly bite or scratch these places. In heavy infestations the injury may be serious. In addition to the local injury there is a loss of nervous energy from irritation. The tick buries

its mouth parts in the dog's skin and sucks blood, and this loss of blood, a relatively unimportant matter in a light infestation with ticks, becomes a serious matter in a heavy infestation. Certain ticks are capable of causing a rapidly fatal paralysis, and cases of the sort have been reported in dogs. Other ticks carry diseases from one animal to another, as in the case of the cattle-fever tick, which carries tick fever of cattle in the Southern States. The brown dog tick of this country carries a disease—canine piroplasmosis—which is very similar to tick fever. The American dog tick has been shown to transmit the eastern form of Rocky Mountain spotted fever of man.

Treatment.—The simplest control measure and one which is usually applicable consists in the removal of the ticks by means of the fingers or with forceps. Occasionally the mouth parts of the tick will be left in the skin and may form festering sores, but this does not occur very often. The control of ticks by hand picking is a time-consuming process, however. For this reason, considerable search has been made for an insecticide which would be effective for the destruction of the parasites and yet safe for the host. It has been reported that an extract of pyrethrum flowers containing a uniform and definite percentage of active ingredients is effective for the destruction of the brown dog tick. Such preparations are marketed under proprietary names. A stock solution is made by mixing 1 part of the pyrethrum extract with 3 parts of a solution of 1½ pounds of green soap dissolved in one-half gallon of water. To this combined solution is added water sufficient to make a dilution of 1 part pyrethrum extract in 19 parts of the soap-and-water solution. The solution is applied by means of a sponge until the coat of the animal is thoroughly saturated with the liquid. This preparation is said to kill larval ticks almost immediately. It is reported that engorged females live for a day or more after treatment, but finally succumb.

A 5- to 7-percent solution of pine-oil disinfectant has been recommended for the destruction of the brown dog tick. The use twice weekly of a powder containing 3 percent of rotenone is reported to be effective for the destruction of these ticks. The use of drugs or chemicals for the destruction of ticks on cats is not recommended. Where animals are exposed to reinfestation, the use of any treatment can only be palliative. Effort should be made to rid premises of ticks in various stages of development by spraying kennels and runs with a hot coal-tar creosote solution or with a pyrethrum emulsion. As the brown dog tick can live for months under favorable conditions without feeding, this is a control measure of great importance.

Whenever possible, dogs and cats should be kept out of tick-infested woods and out of contact with tick-infested stray dogs.

LOUSE INFESTATION

Cause.—The dog is commonly infested with two species of lice. One of these is a sucking louse, the sort commonly present on mammals, and the other a biting louse related to the bird lice.

The sucking louse, *Linognathus piliferus* (synonym, *Haematopinus piliferus*), is pale yellow, less than one twelfth of an inch long, and has a long, slender head (fig. 10), very different from the wide, blunt head of the biting louse. It may appear blue after feeding on blood.

The biting louse, *Trichodectes latus* (synonym, *T. canis*), is clear yellow in color, with darker markings, smaller than the sucking louse, and has a short, wide, blunt head (fig. 11).

Cats are susceptible to attacks by the louse, *Trichodectes subrostratus*, which is about the size of *T. latus* of the dog, but has a more pointed head. This is the only louse infesting cats; it is not common.

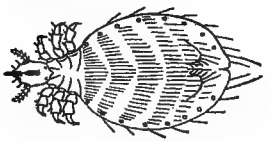

FIGURE 10.—The sucking louse of dogs, *Linognathus piliferus*. Female. Ventral view. Enlarged. From Neveu-Lemaire, 1912. (Measurements: Male, 1.5 millimeters long; female, 2 millimeters long.)

Symptoms.—The sucking lice feed on serum and blood, and the biting lice feed on the scales, scurf, and superficial portions of the skin. In either case they cause irritation, which may be excessive in heavy infestations. The itching due to their bites causes the infested animal to scratch and rub, sometimes causing sores in this manner, and constitutes a drain on the nervous energy. Long-haired dogs appear to be more susceptible to louse infestation than short-haired dogs, and pups and very old dogs are more susceptible to infestation and suffer more from it than dogs of about mature age. The biting louse shares with the flea the role of intermediate host of the common double-pored tapeworm (p. 28), the louse becoming infested with the intermediate stage of the tapeworm as a result of swallowing tapeworm eggs as it feeds on the contaminated skin of the dog, and the dog becoming infested with the tapeworm by swallowing such infested lice. The tapeworm sometimes occurs in man, especially children, infection occurring in the same manner as in the dog.

Treatment.—Lice may be destroyed by dipping the dog two or, preferably, three times at intervals of from 8 to 10 days in one of the coal-tar creosote dips, diluted as stated on the label for use on dogs. Repetition at a suitable interval is necessary, as these dips do not destroy the eggs, and the lice hatching from them must be destroyed before they in turn can lay more eggs. Clipping is an aid in treatment, as it removes many of the eggs which are attached to the hairs and permits better contact and penetration by the insecticide. The hair clippings should be burned to destroy the lice and their eggs (nits). Oils, such as castor oil, cottonseed oil, or olive oil, may be used to destroy lice, the oil being left on for several hours and then washed off with warm water and soap. After being oiled, a dog should be kept in a clean box to keep him from rolling in dirt. A thick lather of whale-oil or fish-oil soap, or an emulsion of 8 parts of the soap to 1 part kerosene may be used, but kerosene must be used with caution, the emulsion well made, and the animal not allowed in the bright sunlight for several hours after treatment. When weather conditions do not permit dipping or clipping, or when clipping is undesirable, palliative measures, not very effective in eradicating lice, may be used. Such measures consist in dusting the hair thoroughly with pyrethrum powder (buhach or ordinary Persian,

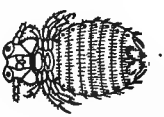

FIGURE 11.—The biting louse of dogs, *Trichodectes latus*. Female. Ventral view. Enlarged. From Neveu-Lemaire, 1912. (Measurements: Male, 1.4 millimeters long; female, 1.5 millimeters long.)

Dalmatian, Caucasian, or Oriental insect powder), allowing it to remain on for half an hour or so, and then combing or brushing it out, with the dead and stupefied lice, on to a newspaper, the paper, lice, and powder then being burned. This treatment must be repeated a number of times in order to keep down the lice. Other powders, containing such insecticides as naphthalene, sulphur, and tobacco, may be used in the same way.

Experiments indicate that derris powder, when fresh, is effective for the destruction of lice on dogs and cats. It is used in the proportion of 1 part of derris to 2 parts of flour or corn starch, the mixture being thoroughly dusted into the hair. Pyrethrum powder also may be used for the destruction of lice on cats. As previously stated, coal-tar creosote preparations or other preparations containing phenol should not be used on cats.

When only biting lice are present they may be destroyed by dusting sodium fluoride into the hair and leaving it on, the animal not being washed for the next 10 days. One application will usually destroy all the lice. The animal should be prevented from licking itself, as 1 gram (about one-fourth teaspoon) of sodium fluoride will kill a dog of average size. This chemical is not of value against sucking lice.

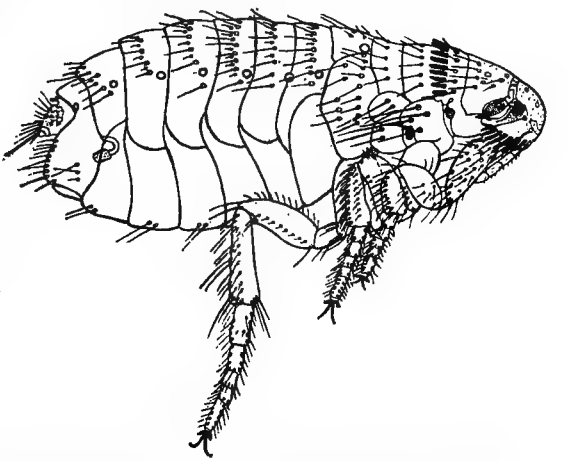

FIGURE 12.—The dog flea, *Ctenocephalus canis*. Female. Lateral view. Enlarged. From Martini, 1923.

FLEA INFESTATION

Cause.—In the United States there are four species of fleas which are of interest as parasites of dogs and cats. These include two very similar species, called respectively the dog flea, *Ctenocephalus canis*, and the cat flea, *C. felis*, the other two being the common human flea, *Pulex irritans*, and the sticktight or chicken flea, *Echidnophaga gallinacea*.

The dog flea (fig. 12) appears to be the most common flea attacking dogs and people in the eastern portion of the United States. It moves about on the host animal between feeds, transfers readily from dog to dog and from dog to man, but is disposed to remain on some host animal rather than off. The eggs laid by the flea fall off the host animal and in the course of time hatch, giving rise to elongate larvae which feed on the animal and vegetable content of the trash present in the dog's bedding or in other places frequented by dogs. In time the larva forms a sort of cocoon, and after a period in the pupal stage the insect emerges as an adult flea. In the house the development from egg to adult commonly takes place in carpets and rugs, and in the trash in cellars and basements. The closely related cat flea has a similar habit and life history.

The human flea (fig. 13) appears to be the most common flea attacking dogs and persons along the western coast of the United States and in parts of the South. It has substantially the same habits as have the dog and cat fleas, but spends more time off its host animal than do these fleas.

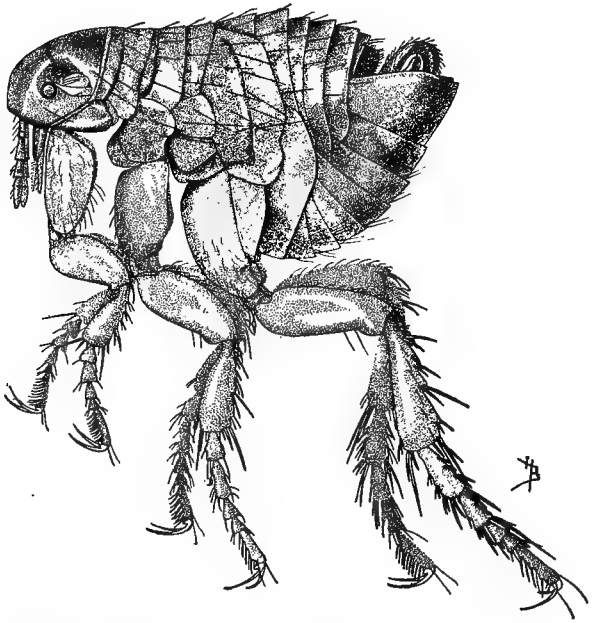

FIGURE 13.—The human flea, *Pulex irritans*. Male. Lateral view. Enlarged. From Bishopp, 1921.

The sticktight flea (fig. 14) is most common in the Southern and Southwestern States, but may occur as far north as Kansas. It is normally a parasite of poultry and may occur on birds in sufficient numbers to cause death. It has little disposition to move about on its host, but remains firmly attached to the skin most of the time. Dogs usually become infested with this flea by contact with infested fowls and premises.

Symptoms.—A number of species of fleas, including the dog fleas, are known to carry the organism of bubonic plague, a very serious disease which man shares with such rodents as rats. This plague occasionally occurs in the United States. The human flea is thought to convey infantile kala-azar at times. The dog flea, cat flea, and human flea act as intermediate hosts of the double-pored tapeworm, just as the biting louse has already been shown to act. In the case of fleas the larval fleas become infested with the larval tapeworms by eating tapeworm eggs present in contaminated trash, in bedding, and elsewhere. Fleas are, therefore, dangerous as carriers of disease and parasites.

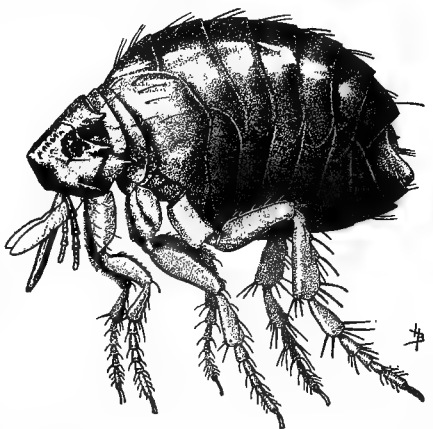

FIGURE 14.—The chicken flea or sticktight flea, *Echidnophaga gallinacea*. Female. Lateral view. Enlarged. From Bishopp, 1921.

Aside from their role as carriers, fleas are not only a cause of discomfort, itching, and irritation to infested dogs and cats, but are especially annoying in that they readily leave their dog hosts to attack man. While a few flea bites cause but little annoyance to some persons, they cause great discomfort to susceptible individuals, and may produce lesions which are more or less serious and heal slowly. Numerous and repeated flea bites cause intense itching and lead to loss of sleep and of nervous energy, a thing which may be a serious matter in summer, when hot weather makes it difficult to sleep even under otherwise favorable conditions.

Treatment.—To be effective any treatment must simultaneously lead to the destruction of the fleas on the animal and of the eggs, larvae, and pupae in bedding and elsewhere. The infested dog may be dipped in a coal-tar creosote solution of suitable strength. If this is not feasible, pyrethrum powder or powdered naphthalene may be used in the manner described in connection with dog lice. Derris powder, as recommended for the destruction of dog and cat lice, is very effective against fleas on dogs and cats. At the same time the kennels and runs should be thoroughly cleaned up, all loose trash burned, and the floors and woodwork scrubbed with a strong, hot coal-tar creosote stock dip. F. C. Bishopp, of the Bureau of Entomology, states that complete control is usually obtained by means of one thorough spraying with a good grade of creosote oil containing between 10 and 16 percent of tar acids. Where sticktight fleas are present on the premises, the infested fowls should be treated by the application of carbolated petrolatum to the clusters of fleas, and the houses, roosts, and other equipment cleaned and disinfected. Where dwellings are flea infested, liberal and repeated application of pyrethrum powder or naphthalene flakes on the floors, rugs, and carpets will serve to control the trouble if the process is carried out thoroughly. In some cases it may be necessary to fumigate with hydrocyanic-acid gas, a proceeding which should be undertaken only by some competent and responsible person. In many places dogs and cats are primarily responsible for the presence of fleas in the house and they should either be kept free from fleas or kept out of the house.

INTERNAL PARASITES AND DISEASES DUE TO THEM

A large number of different kinds of worms have been found in dogs and cats in various parts of the world, but only a few of the more important need be discussed here. Some are important because they are seriously injurious to dogs or cats, and others because they may be transferred in some stage of their development to man and to livestock. Worms are most prevalent in pups and kittens, and are more injurious to them than to mature animals, many pups and kittens dying from worm infestations. This high infant mortality, so to speak, among dogs and cats as well as among human infants, indicates that there is a lack of proper care and of sanitation responsible for it. The remedy among dogs and cats, as among people, is proper care and sanitation. The mother should be free from internal and external parasites before being bred, should then be kept in an area free from parasitic infestation, and the pup or kitten should be born in clean surroundings and raised there until it can fend for itself and until it has acquired some age immunity or resistance to parasitic

infection and to the bad effects of infestation. For parasites, as for other evils, the ounce of prevention is worth the pound of cure. When a pup or kitten is infested with worms it it advisable to use medicinal treatment to remove them, and the more serious the infestation the more urgent the need of treatment, but the younger the animal and the more serious the need of treatment the more dangerous is the treatment. Cats are particularly susceptible to the unfavorable action of drugs and for this reason it is recommended that all treatments for worms in these animals be administered by a veterinarian.

In treating dogs or cats for worms, it should be kept in mind that worm remedies (anthelmintics) if potent are also dangerous, and should be prescribed and administered by a competent veterinarian whenever possible. Among the conditions which make drug administration for worms especially dangerous are extreme youth, age, or weakness of the patient, or the presence of such debilitating diseases as mange or such febrile conditions as distemper. If treatment is imperative under these conditions, diminished doses should be given at 2-week intervals, removing part of the worms present each time and thus protecting the patient. Purgation is highly important in connection with anthelmintics. Adequate doses of a suitable purgative should be given, as a rule, with the anthelmintic, and if evacuation of the bowels does not occur in the course of 3 or 4 hours, another dose of purgative should be given. Enemas may also be given if it seems advisable.

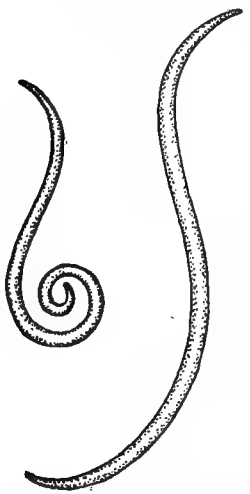

FIGURE 15.—The small white ascarid of dogs, *Toxascaris leonina*. Left, male; right, female. Actual size. From Neveu-Lemaire, 1912.

ROUNDWORM INFESTATION

Cause.—There are two species of roundworms (ascarids) which commonly infest dogs, and both of these occur in the United States. They look very much alike and for practical purposes need not be definitely identified. One of these, *Toxascaris leonina*, is a milky white worm (fig. 15) which may attain a thickness of about one-twelfth inch (2 millimeters); the male is 1.6 to 2.4 inches (5 to 6 centimeters) long, and the female is 2.4 to 5 inches (6 to 10 centimeters) or even 5.4 inches (13 centimeters) long. The internal genital tubes, which can be seen through the body wall, do not extend in the female into the anterior third of the body. This is the worm most likely to be present in mature dogs. The other ascarid, *Toxocara canis*, is pale butter yellow in color, of about the same thickness as the preceding, but usually longer; the male is 2 to 4 inches (5 to 10 centimeters) long, and the female is 2.4 to 7.2 inches (6 to 18 centimeters) or even 8.4 inches (21 centimeters) long. The internal genital tubes extend in the female into the anterior third, and commonly into the anterior ninth, of the body. This is the worm most likely to be present in pups.

Cats, especially kittens, are sometimes infested with roundworms. Two species may be encountered, one being *Toxascaris leonina* and

the other *Toxocara cati*. The latter species is the more common and is very similar in appearance to *T. canis*.

The female worms produce numerous eggs (fig. 16) which pass out in the feces and develop under favorable conditions of warmth and moisture, in the course of 2 or 3 days under very favorable conditions, to the stage where each egg contains an infective embryo worm. When such eggs are swallowed by dogs in contaminated food or water or in other ways, the eggs hatch and the young worms enter the walls of the digestive tract, get into blood vessels or lymph vessels, and finally many of them get to the lungs, usually by way of the blood stream through the liver and heart. In the lungs they leave the blood and enter the air passages, ascend these air passages to the mouth and are swallowed. On reaching the intestine they settle down and grow to mature worms, the females beginning egg production in the course of a few weeks. Prenatal infection of the pups in the uterus of the pregnant bitch has been shown to occur with the second of the ascarids referred to above.

Symptoms.—These ascarids are especially injurious to pups, and as many as 2,000 have been found in one animal. They cause derangements of the appetite and digestion, and heavily infested pups become unthrifty and emaciated and may die if the condition is not relieved. When present in large numbers the worms may form masses which produce a stoppage of the bowels, they may wander into the ducts of the liver, into the stomach, causing the animal to vomit the worms, or may crawl up the esophagus and enter the lungs or nostrils. The young worms leaving the blood and entering the air passages of the lungs may cause such serious injury to the lungs as to produce pneumonia and this may terminate in death.

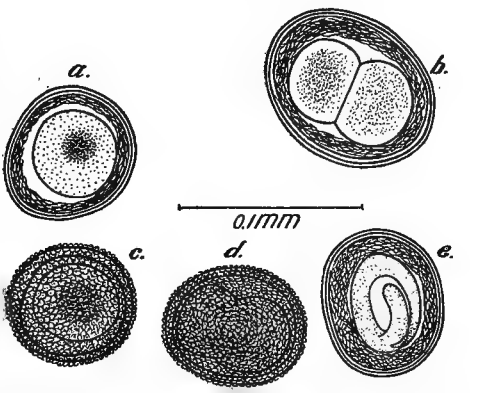

FIGURE 16.—Eggs of dog ascarids: *a, b, e, Toxascaris leonina; c, d, Toxocara canis.* Enlarged. From Wigdor, 1918.

The presence of these worms may be suspected when pups are unthrifty and have a history of passing worms or when they are known to have been associated with older dogs infested with worms. The symptoms of roundworm infestation in cats are about the same as those for roundworm infestation in dogs. Bloating and evidence of acute abdominal pain are the usual symptoms of roundworm infestation in kittens. Diagnosis is best made by a microscopic examination of the feces and the finding of the eggs (fig. 16). This examination can be made by any competent veterinarian.

Treatment.—The most effective drug for removing ascarids from dogs is oil of American wormseed (chenopodium). It may be given in hard or soft gelatin capsules at a dose rate of one-fourth fluid dram (1 cubic centimeter) for a dog weighing 22 pounds (10 kilograms). This should be immediately preceded or followed by 1

fluid ounce of castor oil. The dog may vomit after treatment, but experiments on many dogs show that the treatment will remove all the ascarids present in practically all cases regardless of vomiting. If the bowels do not move in 4 or 5 hours it is advisable in the case of sick or weak dogs to give another ounce of castor oil. As already noted, it is dangerous to give chenopodium to dogs under certain circumstances, and the services of a veterinarian should be obtained if possible to prevent accidents. The feces passed for the 2 days after treatments for worms of any sort should be carefully collected and burned or buried deep, as they have an unusually high content of worm eggs.

Either carbon tetrachloride or tetrachlorethylene, given in the same dose and manner as stated for hookworms (p. 23), is also very effective in removing ascarids from dogs, being only a little less effective than chenopodium; either is safer than chenopodium. In cases of heavy ascarid infestation, particularly in puppies, it is advisable to follow either of the above-mentioned drugs in 5 hours by an adequate dose of castor oil to prevent clumping of the ascarids in the intestinal tract with possible obstruction; or a suitable dose of Epsom or Glauber's salt may be given immediately following the treatment.

Santonin is effective in removing ascarids from dogs when it is properly given. It is usually safe and is especially valuable in the case of animals in which the digestive tract is inflamed. It should be given in the morning, 3 hours before feeding, every day for 5 or 6 days in doses of one-fourth to 1 grain, according to the size of the animal, and accompanied by an equal quantity of calomel.

Oil of chenopodium is twice as toxic for cats as for dogs and should not be used for cats in a dose exceeding 0.05 cubic centimeter for each 2.2 pounds of body weight or 0.25 cubic centimeter for an 11-pound cat, immediately preceded or followed by a purgative dose of castor oil. Tetrachlorethylene administered in gelatin capsules in a dose of one-fourth fluid dram (1 cubic centimeter) for an 11-pound cat, followed in 5 hours by an adequate dose of castor oil, is a safe and effective treatment for the removal of ascarids from cats.

Preventive measures are along the line of sanitation and depend largely on the fact that the infective agents are the worm eggs which pass in the feces. The prompt and thorough removal of these feces from yards and kennels removes the source of infection. Dirt surfaces should be scraped and renewed from time to time, and wooden and concrete structures cleaned with boiling water, soap, and lye, or hot, strong coal-tar creosote solutions, dependence for results being placed primarily on the vigorous and thorough use of a brush. Especial attention should be paid to keeping pups or kittens in clean areas away from infected places and from older animals, and to keeping these older animals free from worms by treatment whenever necessary.

HOOKWORM INFESTATION (KENNEL ANEMIA)

Cause.—Dogs are frequently infected in this country with the common dog hookworm, *Ancylostoma caninum*. This worm (fig. 17) is comparatively small, the male from a little over one-third to one-half inch (9 to 12 millimeters) long, and the female from a little over one-third to almost 1 inch (9 to 21 millimeters) long, and thinner than an ordinary pin. The mouth is armed with six pointed teeth (fig. 18),

and the worm attaches with this armed mouth to the lining of the small intestine and sucks blood. Another dog hookworm, the narrow-headed hookworm, *Uncinaria stenocephala*, is not uncommon in dogs

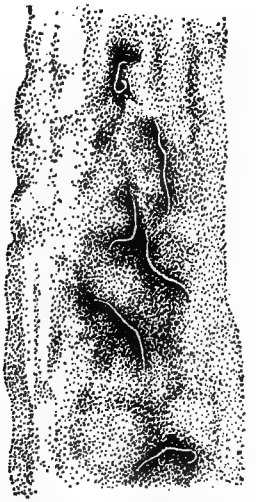

FIGURE 17.—A portion of the small intestine of a dog; slit open to show 6 attached hookworms. Natural size. Adapted from Fiebiger, 1923.

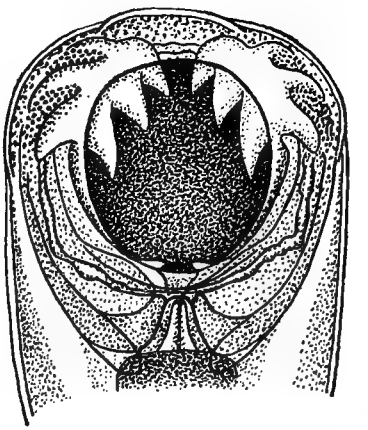

FIGURE 18.—The common dog hookworm, *Ancylostoma caninum*. Head. Dorsal view. Enlarged. From Riley and Fitch, 1912, after Looss.

in Europe and in foxes in the United States and Canada, but appears to be very rare in the dog in this country. This is a smaller worm, the male being one-fifth to one-third inch (5 to 8 millimeters) long,

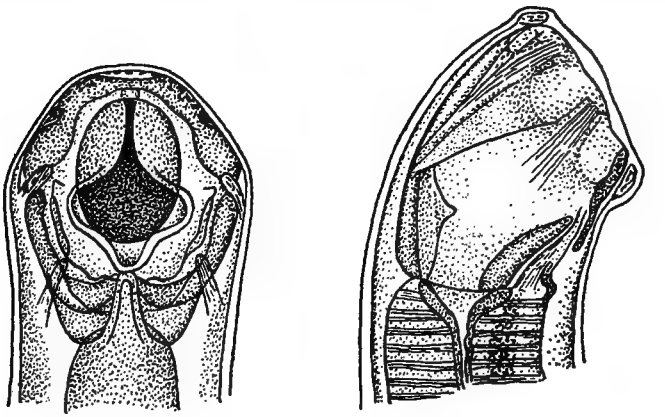

FIGURE 19.—The narrow-headed dog hookworm, *Uncinaria stenocephala*. Head. Left, dorsal view; right, lateral view. Enlarged. From Riley and Fitch, after Looss.

and the female one-third to almost one-half inch (8 to 11 millimeters) long. The mouth is armed with cutting plates (fig. 19), but is without the six teeth which are present in the common dog hookworm. It is, however, a blood sucker like the other.

A third species of hookworm, *Ancylostoma braziliense*, is sometimes found in dogs in the Southern States. This worm is about the size of *Uncinaria stenocephala;* the mouth is armed with 2 large and 2 small teeth. All three of these hookworms may occur in cats, the most common being *A. caninum*.

The female worms produce numerous eggs (fig. 20) which pass out in the feces and under favorable conditions may develop in the course of 36 hours to the stage where each egg contains an active embryo. In the course of from 3 to 6 days, as a rule, a first-stage larva hatches from the egg. In about 3 more days this larva molts its skin and forms a second-stage larva. In about 8 more days this larva molts to form a third-stage larva which retains the skin of the previous stage for a time at least. This is the infective larva, capable of infecting dogs when swallowed in contaminated food or water, or when put in contact with the feet or any part of the dog's skin. Whether the larvae enter by the mouth or through the skin, they go into the circulation and behave in much the same way that the ascarid larvae behave, ultimately getting to the lungs, entering the air passages, going up these to the mouth, being swallowed, and

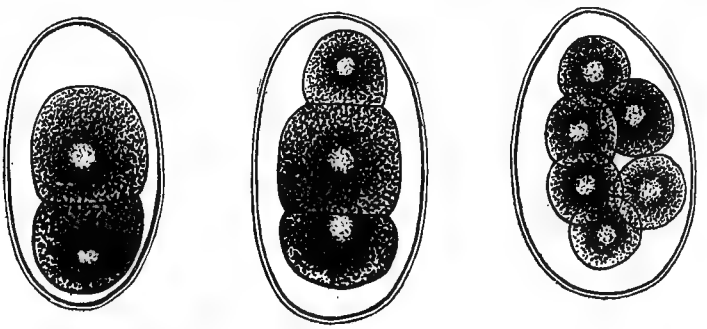

FIGURE 20.—Eggs of common dog hookworm. Enlarged. From Railliet, 1893.

finally reaching the small intestine, where they undergo two more molts and then become mature worms. Eggs from these worms usually appear in the feces in 4 or 5 weeks after infection takes place, but have been said to appear as early as 16 days after infection. In all probability prenatal infection of pups in the uterus of the mother occurs occasionally, and perhaps frequently.

Symptoms.—Owing to the fact that hookworms are bloodsuckers and that such worms not only remove blood from an animal but also appear to produce poisonous substances which exert an injurious effect on the blood, dogs heavily infested with hookworms usually show anemia (a condition in which the blood is thinner and paler than normal, which is shown by a pale color of the mucous membrane in the lining of the mouth and eyelids) and edema (a condition in which there is an accumulation of serum which seeps from the thinned blood into the tissues and accumulates in pendant portions of the body, as under the jaw). The disease is sometimes referred to as kennel anemia. In early stages of the disease there are digestive disturbances, and in later stages there is often diarrhea, sometimes with blood visible in the feces. Owing to the impoverished condition of the blood and to other disturbances due to the worms, the

infested dogs become weak and emaciated, the resistance to disease and to unfavorable conditions is diminished, and the vitality is reduced. In severe cases the following symptoms may be observed: A sunken eye, foul breath, unthrifty coat, reddening of the skin inside the thighs and elbows, pronounced dullness or depression, and a slow healing of operative wounds or accidental injuries, with a tendency to ulcer formation in such cases. The larval worms going through the lungs have been reported as the cause of a fatal pneumonia in pups. Pups are highly susceptible to infection with hookworms and to the bad effects of such infestations and many of them die from hookworm disease, especially in the South.

When the symptoms noted above are present, hookworms may be suspected as the cause, but it is inadvisable to allow dogs to go to the stage where they show clinical evidence of hookworm disease, as such dogs have a diminished resistance to the drugs used in removing the hookworms. In regions where hookworms are prevalent, especially in the South but also in many other parts of this country, the feces of dogs, and especially of pups, should be examined occasionally for worm eggs, and, if they are present, suitable treatment undertaken at once without waiting for ill effects to become evident.

Hookworm infestation in cats is usually light and is likely to be overlooked. Heavy infestations, however, would give rise to symptoms similar to those described previously for dogs.

The larvae of *Ancylostoma braziliense* may attack man and give rise to a progressive type of skin eruption known as "creeping eruption," which is sometimes very difficult to cure.

Treatment.—Carbon tetrachloride in a dose of 0.3 cubic centimeter per kilogram (2.2 pounds) of body weight, or 3 cubic centimeters for a 22-pound dog, is an effective drug for the removal of hookworms. Carbon tetrachloride should not be given to very young dogs or to those suffering from calcium deficiencies, such as rickets, etc. Tetrachlorethylene is an effective drug for the removal of hookworms from dogs. It should be given in a dose of 0.2 cubic centimeter per kilogram of body weight or 2 cubic centimeters for a 22-pound dog. Tetrachlorethylene is a much safer drug than is carbon tetrachloride and should be used in preference to the latter, particularly in the treatment of animals in poor physical condition, in puppies and young dogs, and in those suffering from calcium deficiencies.

Either of these drugs may be given in hard or soft gelatin capsules. Care should be taken to avoid breaking such capsules in the mouth as inhalation of the above-mentioned drugs may lead to serious reactions. Animals should be fasted for 12 hours prior to treatment. The common procedure is to give the usual meal at night, and to administer the treatment in the morning before feeding. Animals may be fed 3 hours after treatment but in case a purgative such as castor oil is administered some time after the anthelmintic, food should be withheld until after its administration. In the ordinary case of hookworm infestation, a purgative is not necessary in connection with the above-mentioned drugs, but in cases of concomitant ascarid infestations, particularly in puppies and young dogs, it is advisable to administer Epsom salt or Glauber's salt immediately following the worm medicine or to give an adequate dose of castor oil 5 hours after the administration of the worm medicine. Some veterinarians prefer milk of

magnesia as a purgative for puppies and young dogs; this may be given immediately following carbon tetrachloride or tetrachlorethylene but an amount sufficient to produce an adequate bowel movement should be administered. Fats, oils, and cream should be excluded from the diet for several days prior to the administration of either carbon tetrachloride or tetrachlorethylene. This applies also in the case of cats.

Tetrachlorethylene is the drug of choice for the removal of hookworms from cats, being much safer for use in cats than is carbon tetrachloride. The dose rate and the manner of administration are the same as for dogs. In cases of concomitant ascarid infestations in cats, a purgative should be given as outlined above.

Ordinarily treatments for worms should not be given to pups until they are weaned, but usually pups 2 weeks old or older may be given tetrachlorethylene with safety. Animals with severe inflammation of the digestive tract appear to be bad risks for this treatment as for most anthelmintic treatments. In connection with the treatment, the same preventive measures given for ascarids should be employed.

WHIPWORM INFESTATION

Cause.—The whipworm, *Trichuris vulpis* (synonym, *T. depressiuscula*), is so named because of its resemblance to a tiny whip (fig. 21), the short, thick posterior portion of the body forming the handle and the slender, anterior portion, which is about three times as long, forming the lash. It is from 1.8 to 3 inches (4.5 to 7.4 centimeters) long. The eggs (fig. 22) produced by the female worms are lemon-shaped, with a knob at each pole. These worms are very common in dogs in the United States but are not known to occur in cats.

The worm eggs pass in the feces and an embryo develops in each egg. As a rule this development is slow, usually requiring several

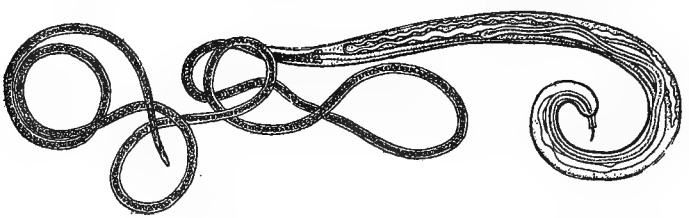

FIGURE 21.—The dog whipworm, *Trichuris vulpis*. Male. Enlarged. From Fiebiger, 1912.

months. When eggs containing these infective embryo worms are swallowed by a suitable host the eggs hatch and the young worms develop for a short time in the small intestine and subsequently in the cecum (the blind gut at the union of the small and large intestines). Here they apparently enter the mucosa by means of a piercing lancet in the mouth of the young worm. As the worm develops, the anterior portion of the body remains sewed into the mucosa, while the posterior portion hangs free in the lumen of the cecum. The worms apparently become mature in about 3 months. In heavy infestations these worms may occur in the colon and rectum as well as in the cecum.

Symptoms.—These worms not infrequently give rise to a low-grade inflammation at the point where they attach, and as they are

most commonly present at the tip of the cecum this is the place where a reddened area is most often seen. The worm's habit of sewing into the mucosa opens small wounds which probably afford entrance for injurious bacteria. A closely related species of worm in man appears to be responsible for symptoms of distress resembling a low-grade appendicitis. The exact symptoms produced by these worms in dogs are as yet matters which require more careful investigation than they have received. In many cases the worms appear to do little harm and to cause no visible symptoms.

Treatment.—Whipworms are not very resistant to the drugs which are injurious to parasitic worms in general, but at the same time the removal of these worms is somewhat difficult. Apparently the reason is that it is difficult to get the drugs in contact with the worms. In their passage through the stomach and small intestines drugs are greatly diluted with the contents of the digestive tract and are also absorbed to a greater or less extent. Of the amount of drug which reaches the ileocolic valve, at the union of the small and large intestines, only a little and perhaps none will enter the cecum or get to its tip where the worms are usually situated. Consequently a single dose of a drug is less likely to reach and kill the worms than it is to miss them. When a number of repeated doses are given, the likelihood of the drug's reaching the worm is greatly increased. At present the most satisfactory and feasible treatment consists in the daily administration of equal amounts of santonin and calomel in the morning, in doses of one-fourth to 1 grain each, according to the size of the dog, the treatment being kept up for a week, suspended for a week, and then repeated for a week. In place of using this routine treatment over a period involving 3 weeks, the treatment may be kept up as long as the whipworm eggs appear in the feces on microscopic examination, suspended whenever they disappear, and stopped if repeated examinations of the feces show that eggs are no longer present.

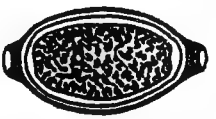

FIGURE 22.—Egg of dog whipworm. Enlarged. From Riley and Fitch, 1921.

HEART-WORM INFESTATION

Cause.—The heart worm, *Dirofilaria immitis*, of dogs and, occasionally, of cats occurs in the right ventricle of the heart and in the pulmonary artery (fig. 23). This worm is long and slender, the male about 5 to 7 inches (12 to 18 centimeters) long, and the female 10 to 14 inches (25 to 35 centimeters) long. The eggs hatch in the uterus of the female worm and the larvae are deposited directly into the blood stream. The heart worm is commonly encountered in dogs in the South but apparently this parasite is extending its range to the North. It is found not only in dogs which have been taken South for hunting or other purposes, but also in dogs born and raised in the North that have never been in the South.

The life cycle of the worm is complex. The larvae which the female worm discharges into the blood are abundant in the blood vessels of the skin, especially at night. Mosquitoes feeding on infested dogs take these larvae into the digestive tract with the blood, and the larvae pass through the walls of the mosquito's stomach and reach the malpighian tubules where they undergo considerable development. Later, the young worms pass to the mouth parts of the mosquito,

escape by breaking through the walls of the labium while the insect is feeding, and enter the blood vessels of the skin through the wounds produced by the bites of the mosquito. The young worms eventually reach the heart where they become sexually mature in 8 or 9 months. Short-haired dogs are more susceptible to heart worms than long-haired dogs, probably because they have less protection against mosquito bites.

Symptoms.—The presence of these worms in the heart may give rise to a variety of symptoms. In hunting dogs the first symptom usually noted is that the animal tires easily; the dog may gasp, breathe heavily and collapse. In cases of long-standing abdominal dropsy, the edematous swellings of the lower part of the chest and legs are common symptoms. A cough may be present, and nervous symptoms, such as photophobia or fear of light, convulsions, and symptoms resembling those of rabies or hydrophobia have been reported. Death may result from asphyxia, embolism, and dilation of the heart.

FIGURE 23.—Heart of dog, showing heart worms, *Dirofilaria immitis*.

Diagnosis is made by microscopic examination of the blood for the presence of larvae; this can be done by any competent veterinarian.

Treatment.—A drug consisting of sodium-antimony-III-bis-pyrocatechin-disulphonate of sodium has been found of value in the treatment of dogs infested with the heart worm. Intramuscular injections are made daily for 6 days each week, treatment being omitted every seventh day. The initial daily dose, administered over the first 6 days, varies from 0.5 to 1.0 cubic centimeter, depending on the weight and condition of the animal. For each succeeding 6-day period, the daily dose is increased by 0.5 to 1.0 cubic centimeter, the maximum daily dose being 3.0 cubic centimeters. In tests in the Bureau of Animal Industry, the total amount of the drug required to effect a disappearance of the microfilariae from the peripheral circulation has varied from 21 to 33 cubic centimeters, and the course of treatment has lasted from 20 to 25 days. Apparently a maximum concentration of antimony in the system is necessary to effect permanent sterilization of the blood stream, and, in general, best results are secured when treatment is pushed to the limit of tolerance in order to attain this concentration as rapidly as possible. However, not all dogs are capable of tolerating a continuous course of injections, and in some cases it may be necessary to suspend treatment for a period of several days if unfavorable reactions occur.

Dogs which are in good condition and which do not show marked symptoms of heart involvement generally tolerate the course of injections without showing marked unfavorable reactions. Other animals show mild to severe systemic reactions which consist in rise in temperature and increase in the respiration and pulse rates. In case

these symptoms appear, it is advisable to suspend treatment until the temperature and pulse rate return to normal.

Experiments indicate that some or all the adult worms are killed by the drug. Treated animals usually show improvement in physical condition, in heart action, and in working capacity.

The drug may be used intravenously also, and the period of treatment can be shortened by the use of this method. For a 40-pound dog, the initial dose is 1.0 cubic centimeter; a dose of 2.0 cubic centimeters is given on the third day; on the fifth, seventh, and eighth days, a dose of 2.5 cubic centimeters; and on the ninth, tenth, and twelfth days, a dose of 5 cubic centimeters is administered.

No standard dose rate for this drug can be prescribed, and emphasis is placed on the fact that the dose must be judged on the basis of degree of infestation and the physical condition, as well as the weight, of the animal. In view of this fact, treatment should be administered only by a veterinarian. Until experience is gained through the use of the drug, a low dose rate should be used for the first 2 or 3 injections in order to establish tolerance of the animal for the drug. In case of severe reactions following the use of the drug, the administration of a suitable dose of a 10-percent solution of calcium gluconate has been found of value.

Prevention consists in keeping dogs from being bitten by mosquitoes. Dogs should be kept away from places frequented by mosquitoes, especially after sundown and in the early morning. Keeping dogs in enclosures screened to keep out mosquitoes is sound practice, and in the Fiji Islands mosquito-proof kennels with self-closing doors have been used.

TAPEWORM INFESTATION

Cause.—Tapeworms are elongated, flat worms made up of few to numerous segments and with a head which is usually provided with 4 suckers and 2 or more hook circlets. The head is located at the small end of the worm. Dogs are infested with a number of kinds of tapeworms, ranging in size from the small hydatid tapeworm, *Echinococcus granulosus* (synonym, *Taenia echinococcus*), which is less than two fifths of an inch (1 centimeter) long, to the marginate tapeworm, *T. hydatigena* (synonym, *T. marginata*), which is from 2.5 to over 16 feet (75 centimeters to 5 meters) long, or to the broad fish tapeworm, *Diphyllobothrium latum* (synonym, *Dibothriocephalus latus*), which may attain a length of almost 30 feet (9 meters). All the dog tapeworms live in the small intestine of the dog. All of them produce eggs which pass out in the feces and which on being swallowed by a suitable host animal will develop to a larval tapeworm, taking the form of a bladderworm of some sort. The host of this bladderworm will be in some cases a domesticated animal, such as the sheep, cow, or pig; in some cases a wild animal, such as the hare or rabbit; in some cases a fish; and in other cases an insect, such as the dog louse or flea. In any case the bladderworm will not occur in the lumen of the digestive tract, but will occur in the tissues, such as the lungs, liver, muscles, mesenteries, brain, or intermuscular or subcutaneous connective tissue, or in the body cavity. In the larger animals, such as sheep, cattle, and swine, the bladderworms may be very large, as in the case of the hydatid, which may attain the size of a child's head and which is often the size of an orange; in insects, such as the flea or louse, the bladderworm is very tiny, as it must be in a host of this size.

Probably the most common of the tapeworms in the dog is the common double-pored dog tapeworm, *Dipylidium caninum*. This

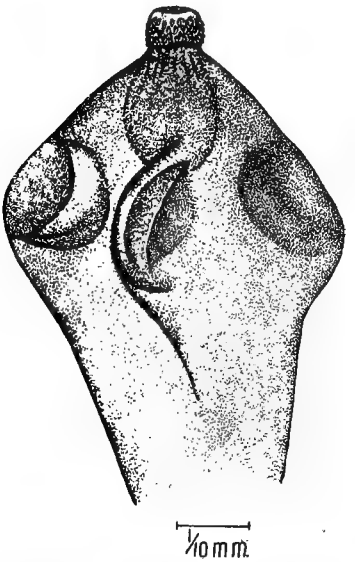

FIGURE 24.—The six-crowned double-pored tapeworm, *Dipylidium sexcoronatum*. Head. Enlarged. From Hall, 1919.

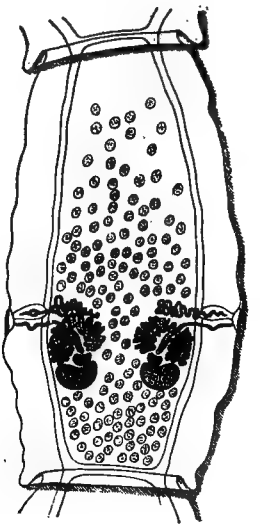

FIGURE 25.—Mature segment of six-crowned double-pored tapeworm, *Dipylidium sexcoronatum*. Enlarged. From Hall, 1919, after von Rátz, 1900.

tapeworm and a closely related species, the six-crowned double-pored tapeworm, *D. sexcoronatum*, have more than two circlets of hooks on the head (fig. 24), and have a genital pore on each side of each segment (fig. 25); the thin-shelled eggs occur in egg capsules (fig. 26) and are often found in these capsules in the feces. The segments may be

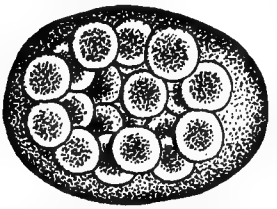

FIGURE 26.—The common double-pored tapeworm, *Dipylidium caninum*. Egg capsule. Enlarged. From Stiles, 1903.

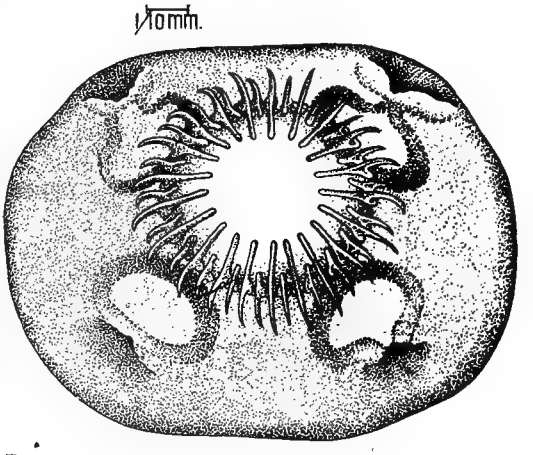

FIGURE 27.—The serrate dog tapeworm, *Taenia pisiformis*. Head, viewed from the front. Enlarged. From Hall, 1919.

white or pink, and the terminal segments break off from time to time and either escape in the feces or creep out of the anus; such escaping

segments are often seen and referred to as rectal worms or pinworms. The common double-pored tapeworm has a larval stage in fleas and the biting lice of dogs. The fleas become infected while they are flea larvae feeding on the organic matter in trash, the larval fleas swallowing the tapeworm eggs in this trash. Biting lice swallow the eggs while feeding on the contaminated skin of the dog. In these insects the tapeworm eggs hatch and the escaping embryo develops to a larval tapeworm in the body of the insect. When dogs, annoyed by the itching and irritation due to these insects, hunt them out and swallow them, the tapeworm larvae become adult tapeworms in the intestine of the dog. This tapeworm sometimes occurs in man, especially in children, as a result of the accidental swallowing of infested fleas or lice by persons.

A larger group of tapeworms is made up of forms which have only two circlets of hooks (fig. 27) and have a genital pore on only one side of each segment (fig. 28). The thick-shelled eggs do not occur in egg capsules but in a uterus from which some eggs escape into the intestinal contents and feces. The eggs (fig. 29) occur as isolated specimens

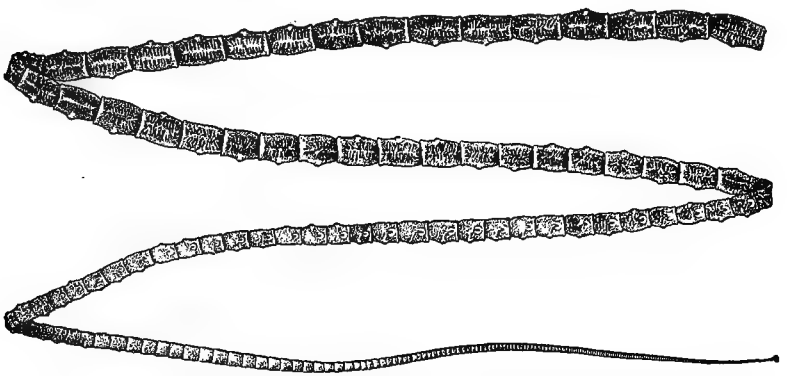

FIGURE 28.—The gid tapeworm, *Multiceps multiceps*. Entire worm. Actual size. From Hall, 1910.

in the feces. The segments, usually containing only a part of the original egg content, escape in the feces and in time break up, releasing the remaining eggs, which are washed about on the ground and on vegetation by the rain. When such eggs are swallowed by suitable hosts, such as sheep, cattle, swine, hares, rabbits, etc., the hosts varying with different species of tapeworms, the eggs hatch and each releases an embryo which penetrates the walls of the digestive tract and develops in some tissue (liver, lungs, muscles, brain, intermuscular or subcutaneous connective tissue, etc.) to form a larval tapeworm or bladderworm (fig. 30). When these bladderworms are eaten by dogs, the tapeworm head in the bladderworm resists digestion and becomes the head of a tapeworm in the intestine of the dog.

Other dog tapeworms include such forms as the broad fish tapeworm, *Diphyllobothrium latum*, which has 2 slitlike suckers in place of the 4 rounded suckers of the preceding forms, and which has its intermediate stages in fish. Dogs become infected by eating infested fish. The broad fish tapeworm also occurs in man.

Cats may harbor the double-pored dog tapeworms, *Dipylidium caninum* and *D. sexcoronatum*, the broad fish tapeworm, *Diphyllo-*

bothrium latum, and the cat tapeworm, *Taenia taeniaeformis* (synonym, *T. crassicollis*), the latter species being the most important. *Taenia taeniaeformis* is from 6 inches to 2 feet (15 to 60 centimeters) long, the head is armed with a double circlet of hooks, and the suckers, four in number, are prominent, pointing forward and outward; there is no neck, segmentation beginning immediately back of the head, and the first segments being as broad as the head or broader. The bladder-worm stage of this tapeworm occurs in the livers of rats, mice, muskrats, and other rodents. Cats become infested by eating the infested livers of these animals.

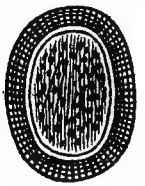

FIGURE 29.—Egg of the serrate dog tapeworm, *Taenia pisiformis*. Enlarged. From Railliet, 1893.

Symptoms.—In general, tapeworms in the dog may cause disturbances in appetite and digestion, a disposition to vomit, general restlessness, and sometimes cramps. In heavy infestations they may cause an inflammation of the digestive tract and occasionally cause occlusion, or stoppage, of the intestine by filling and blocking the intestinal lumen. In addition, tapeworms in heavy or even light infestation may cause more or less well-marked nervous disturbances, in some cases simulating rabies. The passage of a segment or a string of segments through the anus often causes itching or irritation, manifested by the dog's sitting down and dragging itself forward on its haunches. This symptom is sometimes said to be due to pinworms in the dog, but dogs do not have pinworms. The common double-pored tapeworm is especially likely to cause this symptom, and segments of this worm are sometimes referred to as pinworms or rectal worms.

FIGURE 30.—Sheep muscle showing two bladderworms, *Cysticercus ovis*. Actual size. From Hall, 1921, after Ransom, 1913.

Cats infested with *Taenia taeniaeformis* may show loss of appetite, transient diarrhea followed by constipation, salivation and, in some cases, persistent vomiting. In kittens the abdomen may be distended, the animals exhibiting evidences of acute abdominal pain. Nervous symptoms, such as epileptiform convulsions, have been reported as symptoms of tapeworm infestation of cats.

Treatment.—One of the most effective treatments for the removal of tapeworms from dogs consists in the administration of arecoline hydrobromide in doses of one-eighth grain to small dogs, one-fourth grain to dogs of medium size, and one-half grain to large dogs. The treatment is given in the morning after food has been withheld overnight, and no food is given for 3 hours after dosing. No purgative is given with this drug, as the drug usually is itself a very fast and effective purgative. The efficacy of arecoline hydrobromide is said to

be somewhat enhanced by the use of preliminary high colonic irrigations. The drug is quite safe in the majority of cases, but in many cases the animal will appear depressed and subdued for some time after treatment. Very weak or sick animals must be given diminished doses or given some other and safer treatment if treated at all. In any case, and especially in the case of such sick and weak animals, it is advisable to call in a veterinarian. Other drugs which may be used are those such as oleoresin of male fern, kamala, and freshly ground areca nut.

Arecoline hydrobromide may be used for the removal of tapeworms from cats, but the drug is more poisonous for cats than it is for dogs. The dose of the drug is from one twenty-fifth to one-sixteenth grain for adult cats of average weight; the latter dose should not be exceeded. Kamala in a dose of 1 gram in hard gelatin capsules for an average-sized cat is another treatment which is quite effective for the removal of some species of tapeworms from cats. As cats are particularly susceptible to poisoning with tapeworm remedies, it is preferable that such remedies be administered by a veterinarian who is best qualified to judge the proper dose of any such drug.

FLUKE INFESTATION

There have been a number of species of flukes reported from dogs and cats in various parts of the world. One species, *Troglotrema salmincola*, is of special importance, since it is responsible for a fatal disease of dogs known as salmon poisoning.

Cause.—The salmon-poisoning fluke is very small, about one fiftieth to one twenty fifth of an inch (0.5 to 1 millimeter) long, and occurs in the small intestine of dogs. Cats may become infested, but apparently this fluke causes little or no injury to this animal. The distribution of this fluke in the United States is limited to Oregon, Washington, and the northern part of California.

The life history of the salmon-poisoning fluke, like that of other flukes, is complex. The egg of the fluke passes out in the feces and after a period of incubation in water releases a free-swimming larva or miracidium. This larva penetrates into water snails, *Goniobasis plicifera* var. *silicula*, and in the course of time gives rise to other larvae known as cercariae. These cercariae escape from the snail host and penetrate into, and become encysted in, the kidneys and flesh of salmonoid fishes. Dogs and other susceptible animals become infested with the parasite by eating such infested fish.

Symptoms.—The symptoms of salmon poisoning, which develop after the ingestion of infested fish, resemble those of distemper. Recent work by Oregon investigators indicates that the disease is due to a virus, the fluke acting as a carrier of the virus or as an inoculating agent. The disease manifests itself by a sudden rise in temperature about 6 to 8 days after the dog has eaten the infested fish; this rise in temperature is followed by a loss of appetite and marked depression. After the second or third day the temperature drops gradually, and this is followed by a discharge of pus from the eyes and swelling of the eyelids and face. The animal may vomit persistently. On the sixth or seventh day diarrhea sets in, the feces being blood tinged at first and later consisting of almost pure blood. There is a noticeable loss of weight, the temperature drops to subnormal, and usually the animal dies. Recovery is rare, but dogs recovering are immune to subsequent infection.

Treatment.—There is no satisfactory treatment for salmon poisoning; all drugs tried for the removal of the flukes have proved to be ineffective. It is reported that the disease may be prevented by the use of apomorphine within a few hours after dogs have eaten parasitized fish. The best prevention, of course, is to keep dogs from eating raw salmon taken in the area in which salmon poisoning occurs.

TONGUEWORM INFESTATION

Cause.—The tongueworm, *Linguatula serrata* (synonym, *L. rhinaria*), is not a true worm, but is a degenerate relative of the spiders, ticks, etc. It lives as an adult in the nostrils of the dog and some other animals, and in this stage it is a wormlike animal with external ringlike segmentation (fig. 31). This parasite does not infest cats. The male is about four-fifths inch (18 to 20 millimeters) long, and the female is about 3 to 4 inches (8 to 10 centimeters) long. The eggs (fig. 32) from the female worms in the nostrils of the dog pass out in mucus when the dog sneezes or are swallowed and pass out in the feces. When these eggs are swallowed by suitable host animals in eating contaminated vegetation, as by herbivores in grazing, the eggs hatch and the larvae make their way, as a rule, to the liver, lungs, and lymph glands and there develop to the infective stage. In the United States these larval tongueworms are fairly common in cattle in the South; in Europe sheep are the most common intermediate hosts. In view of the fact that the larvae may also occur in man, and that the adult is reported from man in one case, this parasite must be looked on as dangerous. Up to the present time it has been found in the dog only in Georgia, but it undoubtedly has a much wider distribution in this country, as the presence of the larvae in cattle shows, and failure to find it is largely due to failure to look for it.

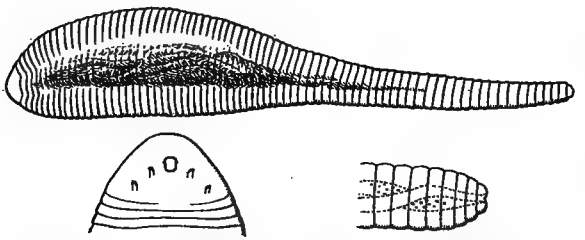

FIGURE 31.—The tongueworm, *Linguatula serrata*. Upper figure, entire animal. Lower left-hand figure, head. Lower right-hand figure, female tail, showing uterovagina (dotted) and intestine. Enlarged. From Sambon, 1922.

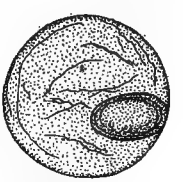

FIGURE 32.—Egg of tongueworm. Enlarged. From Koch, 1906.

Symptoms.—Dogs infested with tongueworms may show no symptoms or may have sudden attacks of sneezing, coming on when the dogs are active for any reason. There is often loud snoring, sometimes with almost complete stoppage of breathing. The animal may rub its nose with its paws as if to remove some obstacle. It is interesting to note that tongueworms have been found in dogs affected with what have been called "running fits" or "fright disease," a condition not yet very well understood. The same condition has been noted in dogs heavily infested with hookworms, and relief reported after successful treatment for hookworms. What relation these parasites or others might have to "running fits" is not known.

Treatment.—No satisfactory treatment appears to have been established. Unless the parasites could be removed by the injection of some suitable substance into the nostrils, treatment would appear to be surgical. In default of successful treatment, dogs known to be infested with tongueworms should be destroyed on the ground that they are carriers of parasites which are dangerous to man and injurious to livestock.

COCCIDIOSIS

Cause.—Coccidiosis in the dog is due to the presence and effects of very small protozoan parasites. There are four species of these parasites reported from dogs. Some of them occur in the epithelium of the intestine and some of them under the epithelium in the submucous connective tissue. The parasites undergo certain developments in these tissues and multiply here. Ultimately they develop resistant forms called oocysts (fig. 33) which pass out in the feces and serve to infect other dogs. Cats are occasionally infected with coccidia but such infections are likely to be overlooked.

Symptoms.—In light infestations coccidia may cause no perceptible symptoms in dogs or cats, but in heavy infestations diarrhea appears at the time when the oocysts are passing in the feces and it may be accompanied by the passage of blood and gas. There may be a slight rise in temperature during this time. Under unfavorable conditions, as in heavy infestations in very weak or young dogs or those with secondary infections, the animals may die. The diagnosis of coccidiosis depends on the finding of oocysts in the feces.

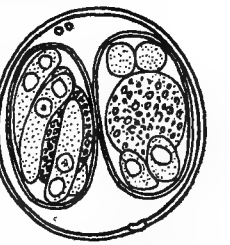

FIGURE 33.—A dog coccidian, *Isospora rivolta.* Mature oocyst. Enlarged. From Wenyon, 1923.

Treatment.—No effective treatment for coccidiosis in dogs or cats is known. However, the disease appears to be self-limited, all of the organisms present developing in the course of time to the oocyst stage and passing out. From observations of the senior author this will probably occur, as a rule, within 2 weeks. There is some evidence indicating that an attack of coccidiosis confers some subsequent immunity. The indicated treatment, therefore, is along the lines of good care and nursing, the animal being fed nourishing food in quantities suited to its condition and protected against unfavorable conditions until the infection terminates. Such symptoms as diarrhea may be controlled by appropriate treatment if necessary. The premises occupied by infected animals must be regarded as infected, and thoroughly cleaned; the use of strong, hot coal-tar creosote dips appears to be of value. Heat and drying are destructive to oocysts. As indicated in the introductory paragraphs, preventive measures for this disease and other parasitic diseases are along the line of sanitation, and sanitary preventive measures are primarily the business of the dog or cat owner. In coccidiosis, as in the other diseases, diagnosis and treatment are primarily the affair of the veterinarian and the employment of a competent veterinarian is always advisable when diseases are actually present.

CANINE PIROPLASMOSIS

Cause.—Piroplasmosis in the dog is due to the presence in the red blood cells of a small protozoan parasite related to the organism causing tick fever of cattle. This parasite is transmitted from infected to healthy dogs through the bites of ticks. Several ticks have been incriminated as vectors of canine piroplasmosis in various parts of the world and among them is the brown dog tick, *Rhipicephalus sanguineus*. It is probable that *R. sanguineus* is the important vector of the disease in the United States, since this tick is common in some parts of this country. (See p. 12.) The extent of canine piroplasmosis in dogs in this country is not known, but one case in Florida has recently come to the attention of the writers.[2] Cats are not known to be susceptible.

Symptoms.—Canine piroplasmosis may be either acute or chronic. In the acute form of the disease the infected animal may show increase in temperature, reddening of the mucous membrances, increased pulse and respiration, loss of appetite, and increased thirst. Jaundice is present in about 50 percent of the cases. Acute cases frequently terminate in death.

In chronic cases fever may be present during the first days of the infection, and in rare cases there may be an intermittent fever. The animals become listless and the mucous membrane pale; jaundice is usually absent in chronic cases. There is a diminished appetite, and the infected animals become greatly emaciated. A positive diagnosis can be made only by microscopic examination of the blood and finding the parasites in the red corpuscles.

Treatment.—Trypan blue is said to be a specific in some forms of canine piroplasmosis. The drug is used in the form of a 2-percent solution in sterile distilled water. It is recommended that the powder be finely triturated with a small quantity of cold water in a mortar and more water added gradually until the dye enters completely into solution, which is then made up to the desired percentage. The solution should be filtered through filter paper and the filtrate autoclaved at a temperature of 120° C. for 20 minutes. When cool, the solution is transferred to sterile bottles which should be carefully sealed. The dose of the solution that has been suggested for a dog of average weight is 5 to 6 cubic centimeters injected intravenously. One dose of trypan blue is usually sufficient to effect a cure in infections with *Babesia canis*, one of the species causing canine piroplasmosis.

Tryparsamide has been reported also as being effective in the treatment of canine piroplasmosis. The dose of the drug for a 25-pound dog is given as 0.85 gram dissolved in 5 cubic centimeters of sterile distilled water, administered intravenously. Best results are obtained following the use of 5 injections with an interval of 5 days between each injection. Other arsenical preparations also have been recommended in the treatment of canine piroplasmosis.

[2] This report is based on a case diagnosed by Dr. Paul Eaton of the Florida Department of Health, the diagnosis being confirmed by Dr. G. Dikmans, of the Federal Bureau of Animal Industry.

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